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AT

HARVARD COLLEGE, IN CAMBRIDGE.

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AMPHISBAENA FULIGINOSA

Contributions to the knowledge of the Brasilian lizards of the family *Amphisbaenidae* Gray, 1825. 6. On the geographical distribution and differentiation of *Amphisbaena fuliginosa* Linné.

By P. E. Vanzolini

From the Departamento de Zoologia, S. Paulo, Brasil.

With Two Plates

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No. 1 — *Amphisbaena Fuliginosa*

By P. E. Vanzolini

INTRODUCTION

The herpetofauna of South America is a very good subject for the study of comparative evolution. Among the circumstances that favor this study are: the heterogeneity of age and origin of the major groups, the diversity of types of environment, the large ranges of many species and the relatively simple geological history of the continent. The South American herpetofauna presents a wealth of evolutionary situations, without the accompanying problems of paleogeography and migration that obscure the phenomena of speciation in other regions, as, for instance, the West Indies.

It is true that an extremely large amount of cataloguing work remains to be done and a still larger amount of very poor taxonomic work to be done over. It is also true that there are practically no collections from considerable portions of the continent.

In some cases, however, the taxonomic situation is clear enough and the number of available specimens warrants an investigation of the features of speciation and even of evolution on the generic level.

Those studies, in my opinion, should be as thorough as possible, presenting not only the conclusions reached but also the complete factual basis for them. I have been told that simple presentation of the results, in the form of a new (or confirmation of a previous) taxonomic situation, is all that is to be desired. This has been the general attitude of the herpetologists working with South American material. They have been on the whole more concerned with the demonstration of the existence of differentiation, and the consequent assignment of subspecific names, than with the establishment of more detailed patterns of variation. It is my belief, however, that only by the accumulation of a very large body of exact information shall we be able to prepare the field for a new work of synthesis, to succeed those of Rensch, Mayr, Huxley and others, that are today an obligatory part of the background of the modern systematist.

In the course of a revision of the Brasilian species of *Amphisbaena* I realized that Amphisbaena fuliginosa would be a desirable subject for a study as delineated above. Besides the evolutionary interest of such a study, it is always useful during the preparation of a revision to make a careful study of variation of the most abundant species, in order to have a sounder basis to extrapolate when dealing with rare forms. I was able to secure 129 specimens of *A. fuliginosa*, representing

58 localities. This is the largest number of New World amphisbaenians of one species ever assembled. Although in some cases fragmentary and insufficient, the material in my hands enabled me to attempt a statistical analysis of the problems of geographical variation and of variability within homogeneous samples of *A. fuliginosa.*

In this statistical analysis I endeavored to use the largest possible number of characters. Seven of them were finally selected: (1) number of body annuli; (2) number of tail annuli; (3), (4) number of segments (dorsal and ventral) on a midbody annulus; (5) number of preanal pores; (6) relative tail length and (7) color.

Other characters usually employed in saurian systematics were found to be unsatisfactory in the case of *A. fuliginosa.* The head shields, for example, present in this species an enormous amount of individual variation; in many cases there were important differences between the right and the left side of the same specimen. Preliminary analysis showed that intra-sample was as large as inter-sample variation and so this whole set of characters was abandoned.

The relative length of the head presented another problem that could not be solved, since there were no satisfactory points of reference for measurement.

Finally, osteological characters show no significant geographical variation in the small series of skulls available and need not be mentioned here.

The problem of geographical differentiation in *A. fuliginosa* has been attacked in two steps.

The first approach has been the investigation of the existence and features of differentiation for each character studied. This has been done chiefly by means of statistical tests for homogeneity and differences between samples from neighboring localities.

All the characters investigated showed geographical differentiation. No case of perfect parallelism between two characters was found. And, in all cases where suitable material was available, intergradation between adjacent samples was detected.

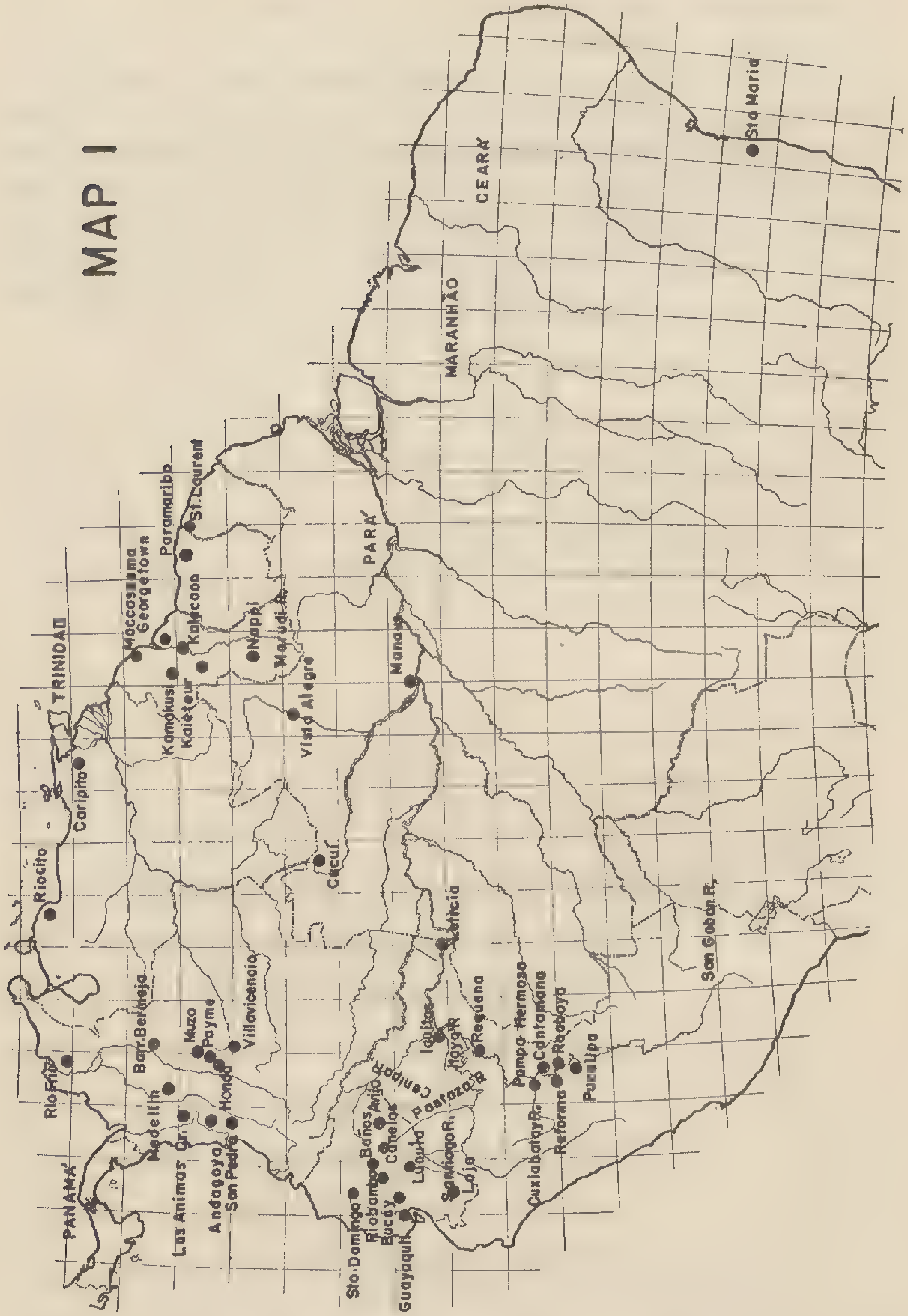
The second step was to assemble these data and to study differences between the several pairs of samples, using all the information available.

As a result of this phase of the investigation it became apparent that no two samples agree in the totality of the characters studied. The broad pattern of variation seems to be of a "checkerboard" type. Some elements, however, lead to the belief that this picture conceals one of adaptive differentiation following expansion of range.

Finally, as a taxonomic result, five subspecies are considered as distinguishable at present; for two of them old names are available; three require new names.

A question has been put to me as to the need for statistical methods in this study.

I do not doubt that the five subspecies here established can be identified without any statistical aid. I am even prepared to concede that they could have been established independently of statistical treatment. This course, however, would have been open to considerable criticism and I would not have any confidence in the results. Furthermore, the establishment of those five races is but a corollary of the analysis of geographical differentiation; this analysis would never have been possible without the use of statistical methods.


MAP I
TRINIDAD
PANAMA'
Riocito
Caripito
Rio Frio
Barr. Bermeja
Medellin
Las Animas Cr.
Andagoya
San Pedro
Muzo
Payme
Hondo
Villavicencio
Maccasseema
Georgetown
Paramaribo
St. Laurent
Kamakusa
Kaieteur
Kalacoon
Napai
Marudi R.
Vista Alegre
PARA'
Manaus
Cucui
Leticia
Iquitos
Nauta
Requena
Pampa Hermosa
Contamana
Roaboya
Pucallpa
Cuxiabatay R.
Reforma
Cenipa R.
Pastaza R.
Baños
Canelos
Santiago R.
Loja
Sto. Domingo
Riobamba
Bucay
Guayaquil
San Gaban R.
MARANHÃO
CEARA'
Sta Maria

Map 1. Localities from which material has been available for this study. No great attempt at precision has been made. Localities omitted: *Cashiboya*, overlaps the mid-Ucayali cluster of localities (Contamana, etc.); *Peña Lisa*, overlaps *Andagoya*; *Aventino*, not located.

TABLE 1

A. fuliginosa — Material used in this study

Locality	*Collection and Number*	*Sex*	*Length*[1]	*Annuli*[2]	*Segm.*[3]	*Pores*
BRASIL						
Manaus, Amazonas	AMNH 64917	♂	152+x	210+x	24/22	8
" "	AMNH 64918	♀	170+21	207+25	22/22	8
" "	AMNH 64919	♀	280+37	211+24	24/24	8
" "	IB 673	♀	260+33	212+25	24/24	8
" "	IB 674	♀	240+30	214+26	24/24	8
" "	DZ 1927	♀	290+40	219+26	26/24	9
" "	MCZ 19540	♂	230+29	220+24	24/24	8
" "	MCZ 20663	♂	270+39	215+26	26/24	8
" "	MCZ 20664	♀	330+40	212+25	22/26	8
" "	MCZ 20665	♂	170+25	220+28	24/24	8
Cucuí, "	AMNH 37442	♂	390+x	208+x	22/22	8
" "	AMNH 37443	♂	205+32	214+29	20/22	8
" "	AMNH 37444	♂	260+x	205+x	22/20	6
Vista Alegre, Amazonas	MCZ 20649	♂	285+41	202+25	22/24	8
—, Pará	USNM 7364	♀	260+x	202+x	26/28	8
—, Maranhão	MCZ 5747	♀	345+x	208+x	24/22	8
—, Ceará	IB 681 A	♂	x+x	214+24	22/24	8
—, "	IB 681 B	♀	250+30	214+25	24/24	10
—, "	IB 681 C	♂	260+40	203+27	20/20	8
Santa Maria, Baía	AMNH 1091	♀	335+51	206+24	26/26	9
" " "	AMNH 1092	♂	280+49	197+28	26/26	10
" " "	AMNH 1093	♂	250+x	202+x	26/24	8
PERU						
Iquitos, Loreto	CM 45471	♀	341+x	213+x	22/22	8
" "	CM 45472	♂	270+40	208+26	24/22	6
" "	AMNH 56224	♂	250+x	208+26	22/22	8
" "	AMNH 56588	♀	450+75	206+27	22/22	8
" "	AMNH 56589	♀	280+47	209+28	22/22	8
" "	AMNH 56590	♂	270+46	205+29	20/24	8
" "	AMNH 56592	♀	330+x	204+x	22/20	8
" "	AMNH 56596	♀	365+64	206+29	22/22	8
" "	AMNH 56597	♂	360+61	211+30	22/22	8
" "	AMNH 56598	♀	305+55	209+29	22/22	8
" "	AMNH 56599	♂	255+52	210+29	22/22	8
" "	AMNH 56600	♀	275+51	210+30	22/22	8
" "	AMNH 56602	♀	300+50	204+28	20/22	8
" "	AMNH 56603	♂	245+39	207+27	22/22	8
" "	AMNH 56605	♀	340+57	205+29	22/22	8
" "	AMNH 56610	♂	395+75	208+29	22/22	8
" "	AMNH 56617	♀	370+60	206+29	22/22	8
" "	AMNH 56618	♀	360+61	210+30	22/22	8

TABLE 1 — (*Continued*)

Locality	*Collection and Number*	*Sex*	*Length*[1]	*Annuli*[2]	*Segm.*[3]	*Pores*
Contamana, Loreto	AMNH 56594	♂	105+16	210+26	20/18	8
" "	AMNH 56609	♀	295+50	208+29	22/22	8
Pampa Hermosa, Loreto	AMNH 56310	♀	365+62	208+28	22/22	8
Cuxiabatay R., "	AMNH 56611	♀	305+46	211+27	22/22	8
Roaboya, Loreto	AMNH 56606	♂	275+42	209+28	20/22	7
" "	AMNH 56607	♂	275+45	211+28	22/20	7
" "	AMNH 56613	♂	245+39	212+26	20/22	7
Requena, "	AMNH 56608	♂	205+35	215+29	22/20	8
Reforma, "	AMNH 56601	♀	315+56	204+29	22/22	8
Pucallpa, "	MCZ 45784	♀	325+48	215+29	20/18	8
Cenipa R., "	AMNH 56593	♀	315+x	196+x	20/22	8
" "	AMNH 56595	♂	290+x	219+x	22/22	7
ECUADOR						
Avila, Napo-Pastaza	SU 8259	♀	365+60	200+26	20/22	8
Pastaza R., Napo-Pastaza	MCZ 37271	♂	370+x	207+x	x x	x
Luoula (Upano R.), Santiago-Zamora	AMNH 28784	♀	380+64	202+27	22/22	9
Luoula (Upano R.), Santiago-Zamora	AMNH 28785	♀	350+x	200+x	20/22	8
mouth of Santiago R., Santiago-Zamora	AMNH 56612	♀	300+55	205+28	20/22	8
between Baños and Canelos, Santiago-Zamora	AMNH 37862	♀	200+x	205+x	22/22	9
Riobamba, Chimborazo	AMNH 2285	♀	340+x	197+x	22/22	8
" "	AMNH 23324	♀	275+44	204+26	22/22	8
" "	AMNH 23325	♂	360+62	203+29	22/22	8
" "	AMNH 23326	♀	295+45	202+26	20/22	8
" "	MCZ 7799 A	♂	345+50	199+23	22/22	8
" "	MCZ 7799 B	♀	320+46	205+25	22/24	7
Bucay, Guaymas	AMNH 22090	♂	350+55	198+25	22/22	7
Daule R., "	MCZ 3572	♀	220+34	196+27	24/20	8
COLOMBIA						
Leticia, Amazonas	MCZ 48959	♀	340+x	214+x	20/22	8
" "	MCZ 48960	♀	250+40	221+26	26/24	10
" "	MCZ 48961	♂	255+39	207+25	24/24	8
Villavicencio, Meta	CM 30583	♀	235+38	208+26	24/24	8
" "	AMNH 62137	♀	440+x	206+x	24/26	8
" "	SU 8272	♂	400+55	207+25	26/26	9
" "	SU 8273	♂	190+30	199+25	24/26	8
Paime, Cundinamarca	MCZ 17647	♀	290+45	196+24	22/20	x

TABLE 1 — (*Continued*)

Locality	*Collection and Number*	*Sex*	*Length*[1]	*Annuli*[2]	*Segm.*[3]	*Pores*
Honda, Boyacá	AMNH 27495	♂	285+45	201+25	22/24	8
" "	AMNH 37455	♀	315+50	205+26	26/24	8
Muzo, "	AMNH 27496	♀	310+45	196+24	22/22	7
" "	MCZ 42189	♀	265+38	290+23	22/20	6
" "	MCZ 46437	♂	250+34	197+24	20/22	6
Medellin, Antioquia	AMNH 37440	♀	280+x	196+x	20/20	6
" "	AMNH 37441	♂	115+19	195+25	24/24	7
Barranca Bermeja, Santander	CM 27575	♂	225+35	200+27	20/22	8
Las Animas Creek, Quito R., Chocó	AMNH 18237	♂	315+47	192+25	24/24	8
Andagoya, Chocó	MCZ 29683	♀	405+58	194+24	22/20	6
San Pedro, Valle del Cauca	AMNH 37439	♀	285+40	201+24	22/24	6
Rio Frio, Magdalena	MCZ 25052	♀	320+50	199+25	22/20	7
VENEZUELA						
Riocito (Acosta), Falcon	MCZ 49049	♀	260+39	200+26	24/26	8
PANAMA						
Panama City	MCZ 37874	♂	240+36	195+24	22/22	8
" "	MCZ 37123	♀	295+x	200+x	24/22	8
Frijoles, Canal Zone	MCZ 24003	♀	240+x	200+x	22/24	8
Barro Colorado Id., Canal Zone	MCZ 22070	♂	315+46	197+24	22/22	8
Monte Lirio, Canal Zone	MCZ 18925	♀	315+x	200+x	22/22	8
" " " "	MCZ 24004	♂	285+42	196+23	24/24	9
near Gatun	MCZ 18924	♂	280+41	195+27	22/22	8
midbasin Chagres R. and Pequeni R.	MCZ 37106	♂	330+x	202+x	24/22	8
Chagres R. (Bohio)	USNM 38399	♂	350+52	198+24	24/24	8
Canal Zone	USNM 37859	♀	305+x	201+x	24/24	8
BRITISH GUIANA						
Marudi R.	AMNH 60907	♀	230+32	218+29	24/22	8
Kaieteur Falls	AMNH 1085	♂	195+29	199+25	22/22	8
Kamakusi	AMNH 25088	♀	205+x	204+x	20/20	8
Kalacoon	AMNH 8731	♀	250+39	205+26	22/22	9
Georgetown	AMNH 17689	♀	420+55	213+24	24/24	8
"	AMNH 7295	♀	305+39	207+24	22/24	9
"	AMNH 17688	♂	230+31	208+25	22/24	8

TABLE 1 — (*Continued*)

Locality	*Collection and Number*	*Sex*	*Length*[1]	*Annuli*[2]	*Segm.*[3]	*Pores*
DUTCH GUIANA						
Paramaribo	AMNH 8134	♀	240+36	207+26	24/22	9
"	AMNH 8135	♀	285+x	206+x	26/26	8
"	AMNH 8140	♀	145+22	205+25	26/22	8
"	AMNH 8649	♂	215+x	196+x	24/24	10
"	AMNH 8650	♂	275+39	206+25	26/24	8
"	AMNH 8678	♀	135+21	199+27	24/22	8
Surinam	USNM 6118	♀	370+x	205+x	28/24	8
"	USNM 58739	♂	225+38	203+27	28/26	9
"	MCZ 15719	♂	350+51	216+25	22/24	8
TRINIDAD						
Toco	MCZ 10137	♀	310+x	205+25	22/22	6
Brackfield	CM 49910	♂	240+37	207+27	22/22	8
San Rafael	CM 49911	♂	245+39	206+24	24/20	8
" "	CM 49912	♀	280+42	206+26	22/24	8
" "	CM 49913	x	x+x	205+x	x x	8
Caparu	AMNH 6968	♀	260+42	206+26	22/24	8
Tucker Valley	AMNH 64440	♂	265+40	211+26	22/24	8
" "	AMNH 64462	♀	215+30	205+24	20/22	8
" "	AMNH 64462 A	♂	250+38	210+25	20/24	7
" "	AMNH 64462 B	♀	210+29	212+25	20/22	6
" "	AMNH 64462 C	♀	195+25	203+24	22/24	6
" "	AMNH 64523	♀	250+x	204+x	20/22	7
" "	AMNH 64523 A	♂	200+26	209+27	20/20	6
" "	AMNH 64523 B	♂	235+36	204+27	20/22	6
— —	USNM 5751 A	♂	262+41	202+25	22/24	6
— —	USNM 5751 B	♂	210+26	205+26	24/26	8

---

[1] Snout to vent length plus tail length.

[2] Number of body annuli plus number of tail annuli.

[3] Number of dorsal segments / number of ventral segments to a midbody annulus.

TABLE 1A

A. fuliginosa — Material arrived too late for statistical analysis

Locality	*Collection and Number*	*Sex*	*Length*	*Annuli*	*Segm.*	*Pores*
PERU						
Rio San Gaban, Loreto	BM 703		275+40	207+27	20/20	8
“ “ “ “	BM 740		275+41	207+27	20/20	7
“ “ “ “	BM 744		335+53	205+27	22/20	7
Cashiboya, “	BM 704		270+x	210+x	20/20	8
ECUADOR						
Santo Domingo	BM 742		295+42	193+23	22/24	8
Guayaquil, Guaymas	BM 741		315+51	200+28	22/22	9
50 km E Loja, Zamora	BM 745		275+41	199+29	20/22	8
COLOMBIA						
Peña Lisa (Condoto), Chocó	BM 714		325+45	202+24	22/24	7
VENEZUELA						
Aventino (not located)	BM 700		310+51	204+28	24/26	8
Caripito	AMNH 69729	♀	260+40	209+27	24/24	6
“	AMNH 69728	♂	175+26	206+28	24/22	6
BRITISH GUIANA						
Maccaseema	BM 747		180+x	205+25	24/26	10
“	BM 748		235+35	207+24	24/26	8
Nappi, Kanuku Mts.	BM 743		265+40	202+26	24/24	10
FRENCH GUIANA						
St. Laurent	CAS 14546	♀	270+x	211+x	28/28	10
TRINIDAD						
—	BM 746		270+36	204+25	22/22	6
—	BM 749		290+45	207+25	24/24	7

MATERIAL AND METHODS

The specimens used in this study are from the collections of the following institutions, to the authorities of which I am much indebted for the loan:

AMNH	American Museum of Natural History, New York City
BM	British Museum (Natural History), London[1]
CAS	California Academy of Sciences[1]
CM	Chicago Natural History Museum
DZ	Departamento de Zoologia (formerly of Museu Paulista), São Paulo, Brasil
IB	Instituto Butantan, São Paulo, Brasil
MCZ	Museum of Comparative Zoölogy at Harvard College, Cambridge, Mass.
SU	Stanford University Museum of Zoölogy, Palo Alto, California.
USNM	United States National Museum, Washington, D. C.

The localities involved were located chiefly by means of the maps published by the American Geographical Society. Government maps of the various countries and collectors' notes were also used.

The statistical analysis is founded on 9 basic samples. Three of these are homogeneous: that from Iquitos, composed of 18 specimens; that from Manaus, of 10; and that from Paramaribo, of 6. The variability of these three samples furnished a check on the adequacy of the remaining six. The latter are composed of specimens from restricted areas of uniform physiographic and climatic features. These samples include: Panama, 10 specimens from the Canal Zone and neighborhood; "Colombian Andes", 8 specimens from Medellin, Muzo, Payme and Honda; "Ecuadorian Andes", 6 specimens from Riobamba plus 1 from "between Baños and Canelos"; "Northern British Guiana", 6 specimens from Georgetown, Kamakusi, Kalacoon and Kaieteur; Trinidad, 16 specimens from various parts of the island; Ucayali River, 10 specimens from localities on the Ucayali between Reforma and Pucallpa.

Between several of these localities specimens of intermediate places are available.

Between Manaus and the "Colombian Andes" one small sample from Cucuí (3 specimens) and another from Villavicencio (4 specimens) provide opportunity for the study of intergradation. Other localities in Colombia are not included in the sample denominated "Colombian Andes": Barranca Bermeja, on the Magdalena, not included because of its situation in a valley, while the remaining localities are in the uplands; Rio Frio, in the Santa Marta region, and Riocito, in Venezuela, for the obvious reason of distance (see Map 1); and 3 localities,

---

[1] The material belonging to these institutions arrived too late for statistical treatment. They brought, however, no modifications to the results already obtained. The localities are included in Map 1 and nowhere else.

2 in the Chocó (Andagoya and Las Animas Creek, tributary to the Quito River, on the upper Atrato) and 1 in the adjacent Valle del Cauca (San Pedro) which are of interest because they are situated west of the Cordillera Occidental; these 3 localities are here called the sample from the Chocó.

Between Manaus and Iquitos we have a small sample (3 specimens) from Leticia. Between Iquitos and the Ecuadorian Andes there is a very interesting series: Cenipa River, Pastaza River, mouth of Santiago River, Avila and Luoula, on the Upano River. On the Pacific slope of the Ecuadorian Andes we have Bucay and the Daule River.

From between Manaus and British Guiana material from 2 localities is available: Vista Alegre on the Branco River and the Marudi River, tributary of the Kuyuwini River.

From Dutch Guiana 3 specimens labelled simply "Surinam" must probably come from the interior and may be considered, with due reserve, as intermediate between Paramaribo and Manaus.

Some Brasilian specimens present a problem. No suitable sample could be assembled from the sparse material. One specimen labelled only "Pará" is not useful because Pará is a very large state and, from the point of view of the geographical relationships here examined, a complex one. This is not the case with a specimen from the State of Maranhão that may be considered between the Amazon Valley and the State of Ceará. Finally, 3 most surprising specimens from "Santa Maria", collected by Maximilian, Prince of Wied Neuwied, were a problem until Dr. Oliverio Pinto (of the Dep. de Zoologia, São Paulo) definitely ascertained the precise locality to be an old Jesuit fazenda on the lower Ilheus River.

As to the statistical methods used, they were the simplest possible. They can be found in Simpson and Roe (1939), to whose work reference is made at suitable places, saving thus the necessity of explaining them at length. Klauber's methods were applied according to his papers, duly quoted in their appropriate context. In some cases Fisher (1948) was used; reference is made to chapter and section, instead of page, to make easier the use of older editions.

All the statistical tests were performed with the aid of Fisher and Yates' (1949) tables. In the calculations use was made of Barlow's (edited by Comrie, 1944) and Miner's (1947) tables.

No significant sexual differences were found in the samples analyzed. Consequently all the samples were treated without reference to sex. The small size of the samples and the preliminary character of this study warrant this procedure.

Finally, no attempt was made at uniformity of statistical treatment. The methods employed were those found best suited for the individual problems under investigation.

GEOGRAPHICAL DIFFERENTIATION OF SINGLE CHARACTERS.

1. Number of body annuli.

The number of body annuli is one of the best taxonomic characters of the amphisbaenians. Consistent counts, however, are not easy to obtain, as the annuli are not always regular and there are many partial doublings and splittings.

A method of counting was devised that afforded fairly consistent results with a minimum of time and effort. The specimen is held under the microscope by the operator's left hand; the tail, turned forward, is held between the middle and index fingers of the same hand while the thumb presses the abdomen. The annuli are counted along a line to the left of the medio-ventral line (to the right of the operator). A first count is made craniad and a second one caudad along the same line. The foremost annulus to be counted is the first complete one back of the oral commissure and the hindmost the one that bears the preanal pores. The two counts usually agree and the result is then recorded. If they do not agree, as is the case with specimens badly twisted or desiccated, 5 counts (3 in one and 2 in the opposite direction) are then made and the rounded mean recorded.

TABLE 2

Amphisbaena fuliginosa

Number of body annuli of 9 basic samples

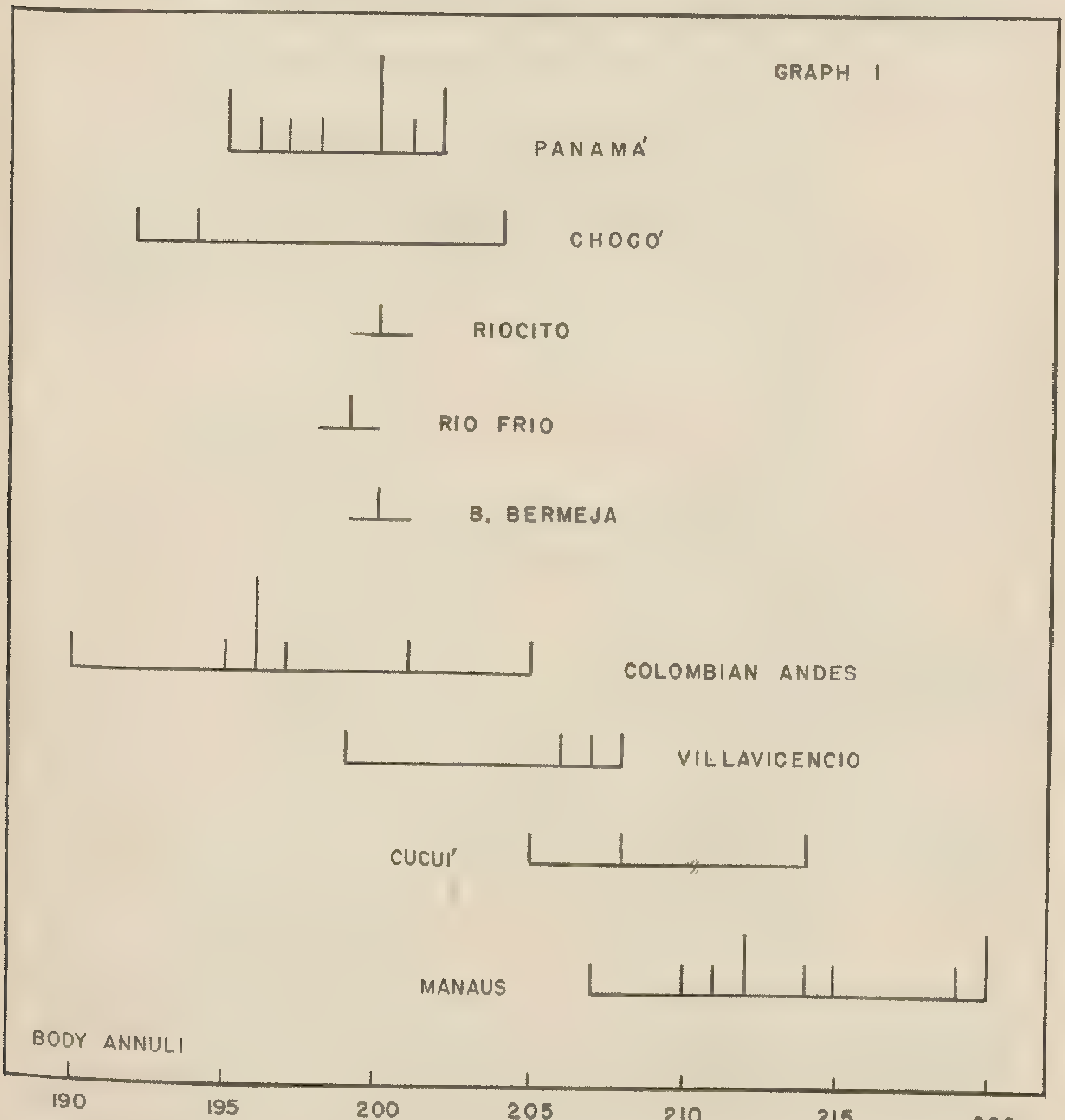
Localities	*N*	*R*	*M*	σ	*V*
Manaus	10	207–220	214.0 ± 1.41	4.5 ± 1.00	2.1 ± 0.5
Colombian Andes	8	190–205	197.0 ± 1.56	4.4 ± 1.10	2.2 ± 0.6
Panama	10	195–202	198.4 ± 0.81	2.6 ± 0.57	1.3 ± 0.3
Iquitos	18	204–213	207.7 ± 0.62	2.6 ± 0.44	1.3 ± 0.2
Ucayali River	10	204–215	210.3 ± 1.05	3.3 ± 0.75	1.6 ± 0.4
Ecuadorian Andes	7	197–205	202.1 ± 1.16	3.1 ± 0.82	1.5 ± 0.4
N. British Guiana	6	199–213	206.0 ± 2.08	4.7 ± 1.47	2.3 ± 0.7
Paramaribo	6	196–207	203.2 ± 1.85	4.5 ± 1.31	2.2 ± 0.6
Trinidad	16	202–212	206.3 ± 0.72	2.9 ± 0.51	1.4 ± 0.2

The statistics calculated for the 9 samples above mentioned are presented in Table 2. In this and similar tables

N is the number of individuals in the sample
R is the observed range of the variable
M is the arithmetic mean
σ is the standard-deviation
V is the coefficient of variation.

The figures that follow these statistics, separated by a ± signal, are the respective standard-errors (Simpson & Roe, 1939: 85, 107, 112, 121, 149).

Inspection of this table shows that homogeneity of the several samples is not to be expected. Analysis of variance shows them to be heterogeneous (Fisher, 1948: 7, 40, 41).



Graph 1. *A. fuliginosa.* Variation of the number of body annuli in the territory between Manaus and Panama.

The sample with the highest mean is seen to be Manaus (214.0); the lowest means are to be found in the Colombian Andes (197.0) and Panama (198.4).

Analysis of variance among these three samples shows that they cannot have been drawn from the same population. Differences between the Colombian and Panamanian samples are not significant, even if the coefficient of variation is low in the sample from Panama. Both the Colombian and Panamanian samples differ significantly from the Manaus one.

TABLE 3

Amphisbaena fuliginosa — Number of body annuli. Probabilities of the *t* test between the basic samples and intergrading material.

Manaus — Colombian Andes — Panama

Localities	*Body ann.*	*M*	*Manaus*	*Col. Andes*	*Panama*
			M = 214.0 *R = 207–220*	*M = 197.0* *R = 190–205*	*M = 198.4* *R = 195–207*
Cucuí	205 208 214	209.0	0.10	0.01	
Villavicencio	199 206 207 208	205.0	0.01	0.001	
Barranca Bermeja	200			0.50	0.55
Rio Frio	199			0.65	0.80
Riocito	200			0.50	0.55
Chocó	192 194 201	195.7		0.70	0.20

In this and similar tables

M is the mean of the samples
R their observed ranges

The variation in the number of body annuli along this line is shown in Graph 1, wherein it may be noted that Cucuí and Villavicencio are represented by intermediate specimens. The intermediate character of these samples may receive numerical expression. Taking the difference between the mean of the larger samples (basic) and the mean of the small intermediate samples (or single specimens) we can calculate the respective value of t (Simpson & Roe, 1939: 209–210). This t corresponds to a probability of such a difference (or a larger one) arising by chance between samples taken at random from the same population. This probability is a good enough estimate of the closeness of the intergrades to the contrasted samples. Table 3 presents these probabilities (approximate values) for the line here discussed (Manaus-Colombian Andes-Panama).

The figures in the table are the probabilities that differences such as the ones observed occur within homogeneous populations because of sample fluctuations. Probabilities equal or smaller than 0.05 (5%) are taken as significant, i.e., indicate that the probability of the two samples belonging to the same population is negligible.

From the data in Table 3 it may be concluded that:

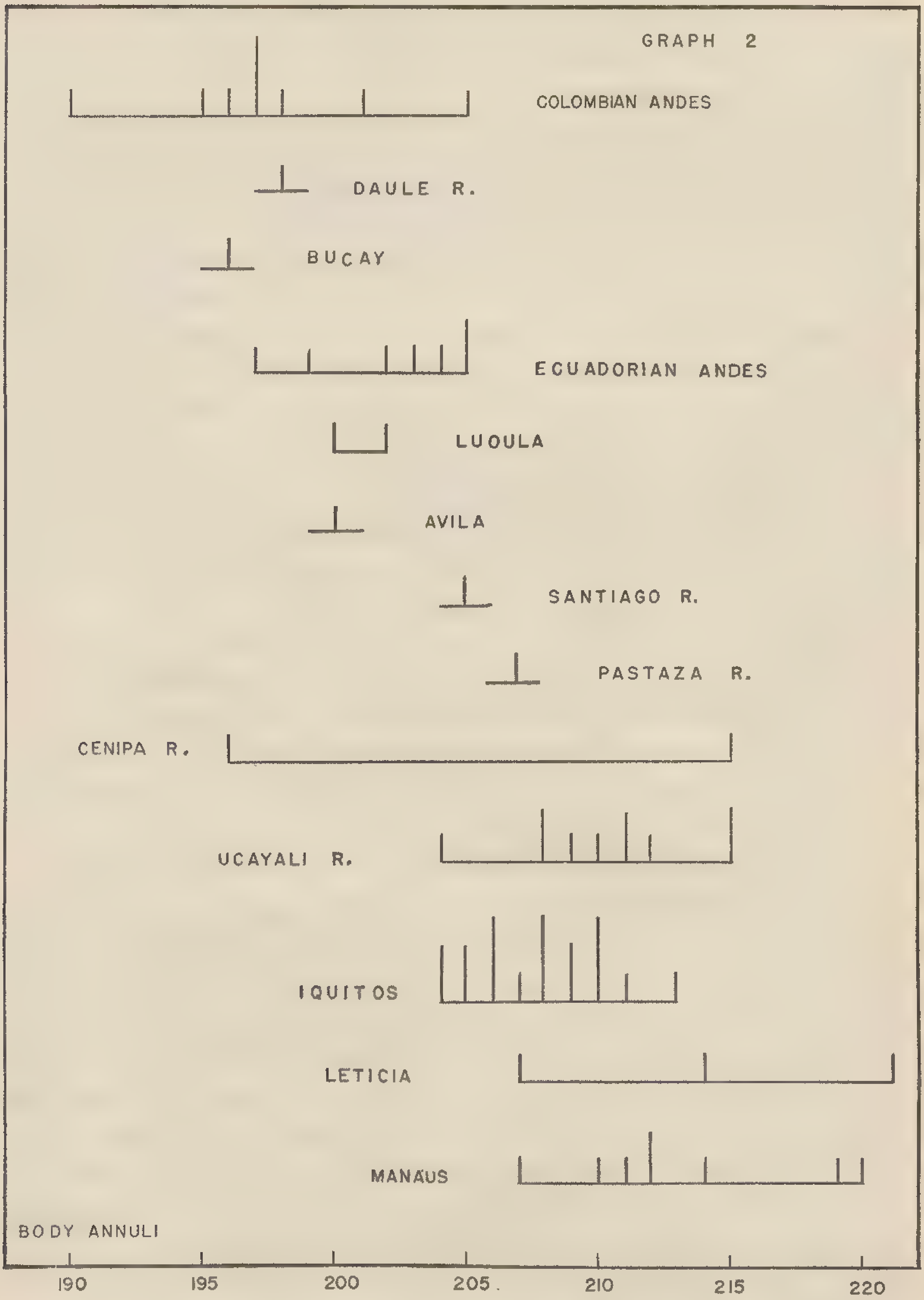
a. the samples from Manaus and the Colombian Andes belong to different populations with regard to the number of body annuli;
b. these populations are linked by intergrades;
c. the zone of intergradation comprises Cucuí (near its Amazonic end) and Villavicencio (near its Andean end).

We have here what seems to be the picture of differentiation between a lowland and a highland form.

It has already been noted that no significant differences were found between the Colombian Andes and Panama. Other available material must be considered in this connection (Map 1, Table 3, Graph 1).

Barranca Bermeja shows agreement with both samples. So do the specimens from Rio Frio and Riocito. The sample from the Chocó offers special interest: it agrees both with the Panamanian and the Colombian material, being possibly a shade nearer to the latter. This tends to show that a low-count population found in the uplands of Colombia extends north to the Isthmus of Panama and the northwestern coast of Colombia; to the west it probably reaches the Pacific coast. The exact limits to the east cannot be ascertained, due to lack of material from Venezuela.

Let us now consider the variation of the number of body annuli from another angle. The sample from Riobamba and neighborhood (Ecuadorian Andes) differs significantly from the Manaus one. Using the same methods as for the Colombian sample we may investigate the existence of intergradation in the case of these samples (Graph 2, Table 4).



Graph 2. *A. fuliginosa.* Variation of the number of body annuli in the territory between Manaus and the Pacific coast of Ecuador. Colombian sample introduced for comparison.

Specimens from Leticia agree entirely with those from Manaus. Iquitos material, however, is definitely intermediate and intergradation proceeds from Iquitos up to the foothills of the Andes (Avila, Luoula) where agreement is reached with the upland material. In this connection it is interesting to note that counts of the two specimens from Rio Cenipa approach both limits of the distribution (196 and 219).

Two amphisbaenids from near the Pacific coast (Daule R. and Bucay) agree with the upland series, although both provide values closer to the lower limit of the range; they agree much better with the Colombian material.

The sample from the Ucayali River presents a mean significantly different from both Manaus and Iquitos, and closer to the latter.

TABLE 4

Amphisbaena fuliginosa — Number of body annuli. Probabilities of the *t* test between the basic samples and intergrading material.

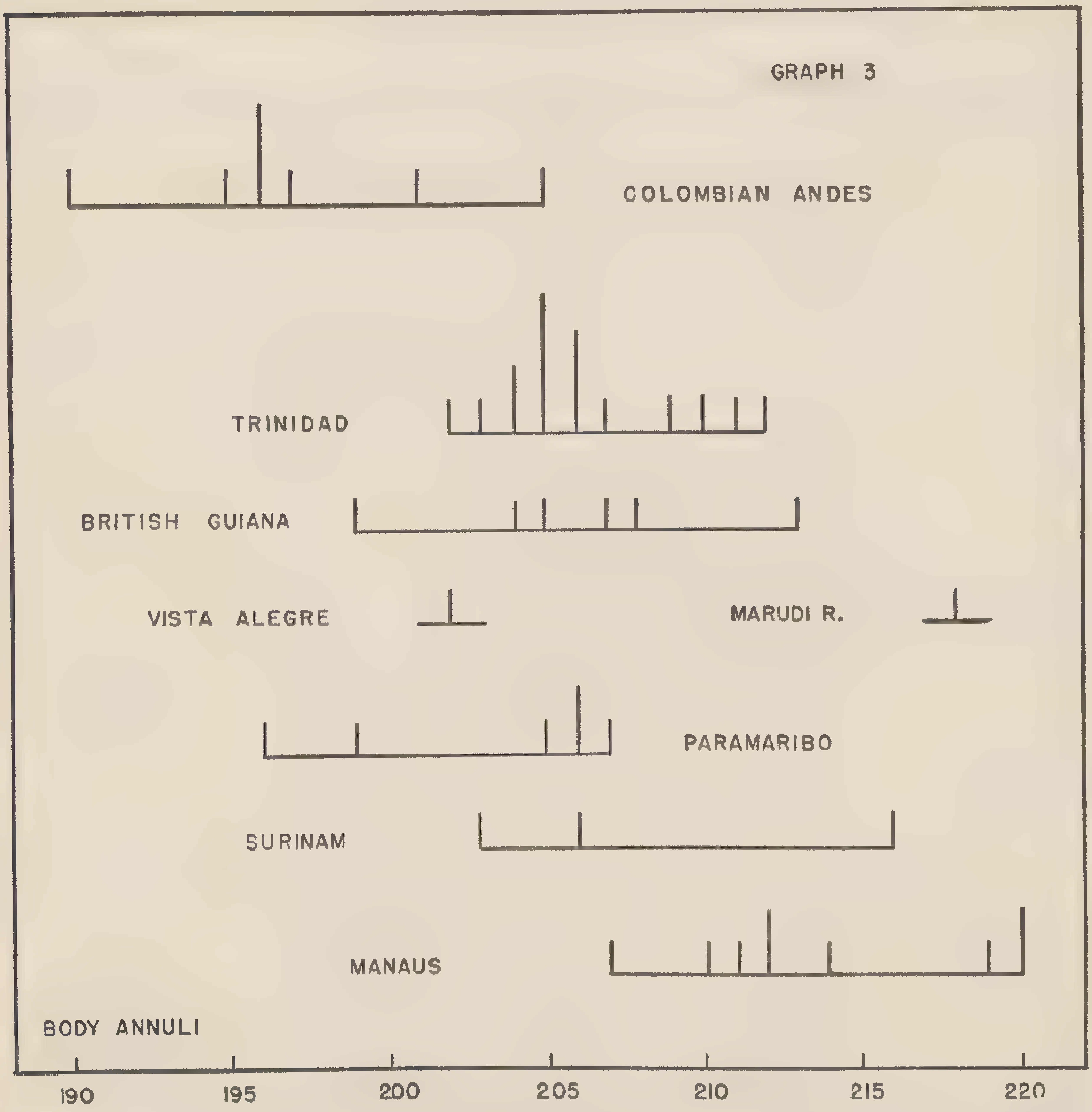
Manaus — Iquitos — Ecuadorian Andes

Localities	*Body ann.*	*M*	*Manaus*	*Iquitos*	*Ecuad. Andes*
			$M = 214.0$ $R = 207\text{–}220$	$M = 207.7$ $R = 204\text{–}213$	$M = 202.1$ $R = 197\text{–}205$
Leticia	207 214 221	214.0	1.0	0.01	0.001
Ucayali R.		210.3	0.045	0.035	0.001
Cenipa R.	196 219		0.001 0.30	0.001 0.001	0.10 0.001
Pastaza R.	207		0.15	0.80	0.15
Avila	200		0.01	0.02	0.55
Santiago R.	205		0.075	0.30	0.40
Luoula	200 202		0.01 0.03	0.02 0.04	0.55 0.99
Bucay	198		0.01	0.001	0.25
Daule R.	196		0.001	0.001	0.10

Comparing the Ecuadorian and Colombian material we see that they do not agree, but that the former is intermediate between the latter and the high count populations (as represented by Iquitos).

We can summarize variation in this region by stating that there are two distinct lowland populations (Manaus and Ucayali River) with high averages; these seem to intergrade between themselves and with a low count highland population. The intergradation belt comprehends the upper Amazon, the foothills of the Andes in Ecuador and Colombia and the Ecuadorian Andes.

The northern coast of South America is here represented by material from Trinidad[1], northern British Guiana and Paramaribo. (Graph 3, Table 5).



Graph 3. *A. fuliginosa.* Variation of the number of body annuli in the territory between Manaus and the northern coast of South America. Colombian sample introduced for comparison.

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[1] Trinidad is taken here as representing the mainland stock that colonized the island. Even if there has been differentiation of the insular population, it will resemble the parent form rather than any other. This fact will receive fuller discussion in a later section.

These samples are shown by analysis of variance to be reasonably homogeneous, although Paramaribo shows a tendency toward low counts. The three samples differ significantly from Manaus both individually and taken together.

We have already commented upon the scarcity of intergrades in this region. The two specimens from Vista Alegre and from the Marudi River possess the same features as those from the Cenipa River; although the localities are very close, the values are far apart. The specimens from Surinam behave as colorless intergrades. These samples from the northern coast of South America also differ significantly from those of Colombia and Panama. They show values close to the ones found in Villavicencio and Iquitos, but significantly higher than the samples from Ecuador.

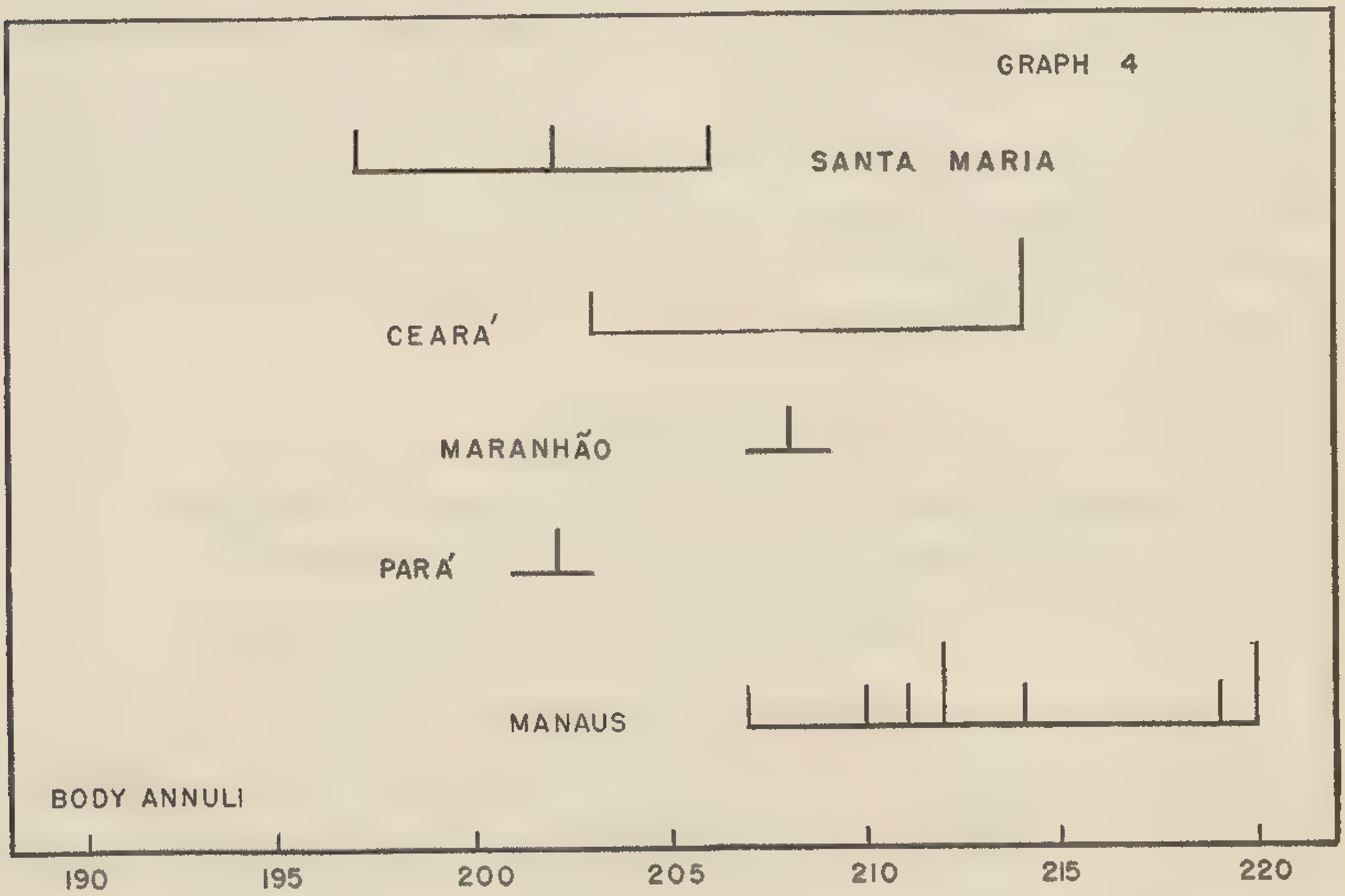
TABLE 5

Amphisbaena fuliginosa — Number of body annuli. Probabilities of the test of *t* between the basic samples and the intergrade material.

Manaus — Guianas and Manaus — Brasilian samples.

Localities	*Body ann.*	*M*	*Manaus*	*N. Brit. Guiana*	*Paramaribo*
			M = 214.0 *R = 207–220*	*M = 206.0* *R = 199–213*	*M = 203.2* *R = 196–207*
Vista Alegre	202		0.02	0.40	
Marudi R.	218		0.40	0.03	
Surinam	203 205 216	208.0	0.10		0.30
Pará	202		0.02		0.50
Maranhão	208		0.20		
Ceará	203 214 214	210.3	0.30		
Santa Maria	197 202 206	202.7	0.01		

The remaining Brasilian material includes samples with a peculiar distribution of values. The Maranhão and Ceará specimens, although not significantly different from the Manaus ones, provide lower values. The specimens from Santa Maria, however, differ significantly from those of Manaus, approaching the values found in those of Ecuador.

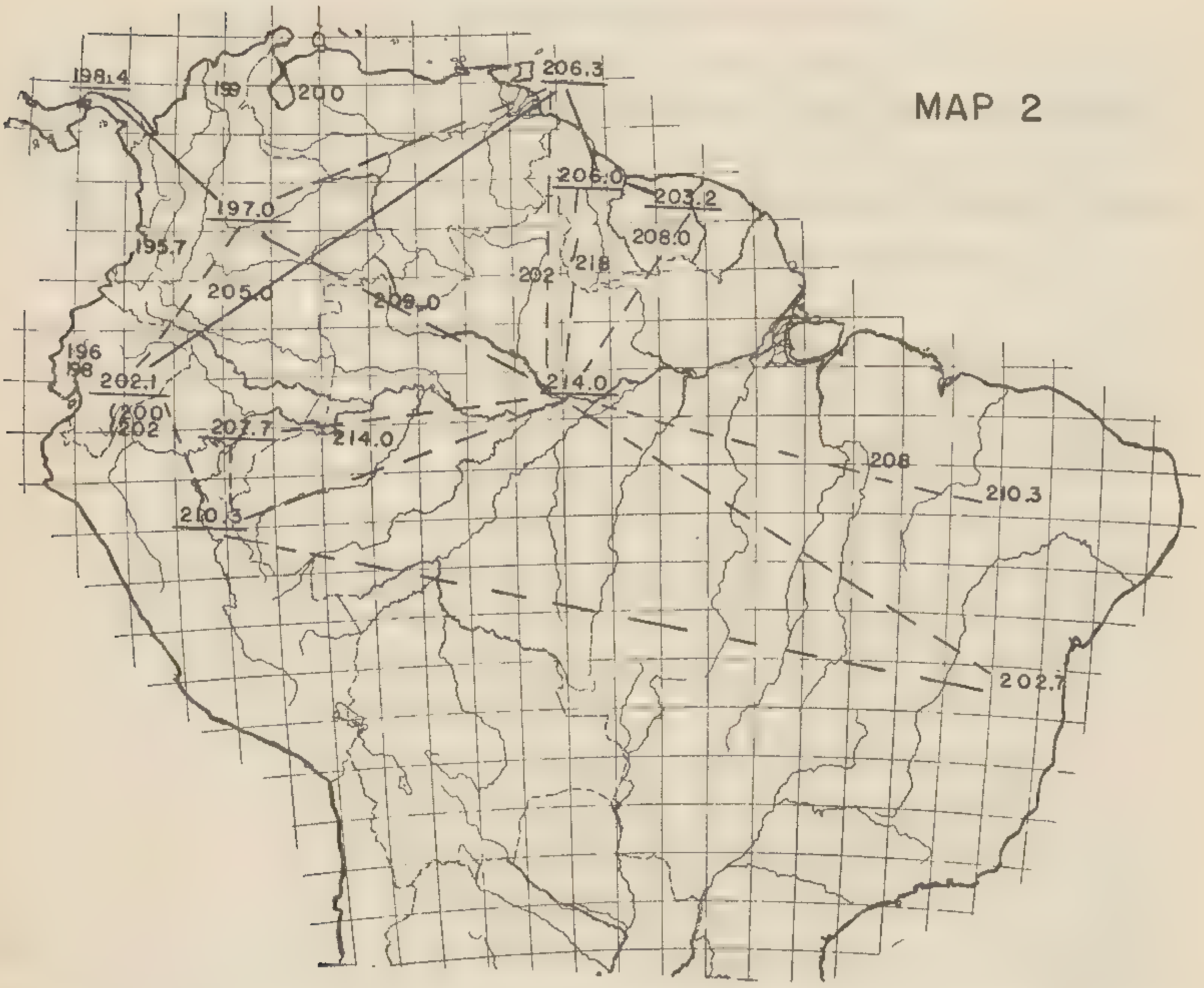


Graph 4. *A. fuliginosa.* Variation of the number of body annuli in the Brasilian territory south of Manaus.

The general pattern of variation of the number of body annuli in *A. fuliginosa* seems to be the following, as nearly as one can judge from the present material:

A population with a high count occupies the Middle Amazon valley, at least from Manaus to Leticia. Surrounding this population there is an interrupted ring of populations having low counts. Among those the lowest values are found in Colombia and Panama. Wherever critical material is available, intergradation between populations with high and low counts is evident.

These relationships are depicted in Map 2 and will be discussed later, together with the results of the study of variation of other characters.



Map 2. *A. fuliginosa.* Geographic differentiation of the number of body annuli. The decimal numbers are averages of samples; the underlined ones belong to the 9 major samples, the remainder to the small samples of 3 and 4 specimens. Integers refer to isolated specimens. The figures are placed on the approximate location of the place. The series between Iquitos and the Ecuadorian Andes has been partially suppressed to avoid overcrowding (see Graph 2). Broken lines between two numbers mean that the difference between them is statistically significant; solid lines that the difference is not significant.

2. Number of tail annuli

The number of complete tail annuli between and including the first one behind the cloaca and the tip of the tail is also a useful taxonomic character for the separation of species in the *Amphisbaenidae.* In some of them, however, there is an anatomical feature that deprives the character of much of its usefulness. In such forms as *A. mertensii* (Vanzolini, 1948), *A. fuliginosa*, *A. subocularis*, *A. spurrelii*, *A. slevini* and others the proximal annuli are of normal shape, resulting in a cylindrical segment of tail; there is, at the end of this segment, a shorter and a little narrower annulus, the ones distal to it being somewhat swollen. This shorter annulus is the commonest level for fractures, which are frequent. The truncated stump heals completely, a fact that has resulted in erroneous assumptions.

In the material for this study 28 out of 129 specimens (21.7%) have mutilated tails, but the percentage is unequally distributed among the samples. In the Panama series 5 out of 10 specimens are mutilated; in the Iquitos series 2 out of 18; while in the Ucayali River sample all are perfect.

The raw data on the distribution of tail annuli in the different samples are presented in Table 6.

TABLE 6

Amphisbaena fuliginosa — Number of tail annuli. Frequency distribution in all the material available.

Locality	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*Total unbroken tails*	*Mutilated tails*	*Total*
MANAUS		2	3	3	1				9	1	10
Cucuí							1		1	2	3
Villavicencio			2	1					3	1	4
COLOMBIAN ANDES	1	3	2	1					7	1	8
Barranca Bermeja					1				1	–	1
Rio Frio			1						1	–	1
Riocito				1					1	–	1
Chocó		2	1						3	–	3
PANAMA	1	3			1				5	5	10
Leticia			1	1					2	1	3
IQUITOS				2	2	2	7	3	16	2	18
UCAYALI RIVER				2	1	3	4		10	–	10
Cenipa River									–	2	2
Pastaza River									–	1	1
Avila				1					1	–	1
Santiago River							1		1	–	1
Luoula					1				1	1	2
ECUADORIAN ANDES	1		1	2			1		5	2	7
Bucay			1						1	–	1
Daule River					1				1	–	1
Vista Alegre			1						1	–	1
Marudi River							1		1	–	1
N. BRITISH GUIANA		2	2	1					5	1	6
Surinam			1		1				2	1	3
PARAMARIBO			2	1	1				4	2	6
TRINIDAD		3	4	4	3				14	2	16
Pará									–	1	1
Maranhão									–	1	1
Ceará		1	1	1					3	–	3
Santa Maria						1	1		2	1	3
Total									101	28	129

The restricted range of variation of this variable does not favor study of intergradation by the methods used for the body annuli. The best results are achieved by using tests of significance of differences between means.

Inspection of Tables 6 and 7 shows that two samples present outstanding values among all: Ucayali River and Iquitos.

TABLE 7

Amphisbaena fuliginosa — Number of tail annuli in the basic samples.

Locality	*N*	*R*	*M*	*σ*	*V*
Manaus	9	24–27	25.3 ± 0.51	1.54 ± 0.36	6.1 ± 1.5
Colombian Andes	7	23–26	24.4 ± 0.38	1.00 ± 0.27	4.1 ± 1.1
Panama	5	23–27	24.4 ± 0.67	1.50 ± 0.44	6.2 ± 2.0
Iquitos	16	26–30	28.4 ± 0.32	1.27 ± 0.22	4.5 ± 0.6
Ucayali River	10	26–29	27.9 ± 0.38	1.20 ± 0.27	4.3 ± 0.9
Ecuadorian Andes	5	23–29	25.8 ± 0.97	2.18 ± 0.70	8.5 ± 2.7
N. British Guiana	5	24–26	24.8 ± 0.39	0.87 ± 0.27	3.6 ± 1.1
Paramaribo	4	25–27	25.8 ± 0.45	0.91 ± 0.32	3.6 ± 1.3
Trinidad	14	24–27	25.5 ± 0.29	1.07 ± 0.20	4.2 ± 0.8

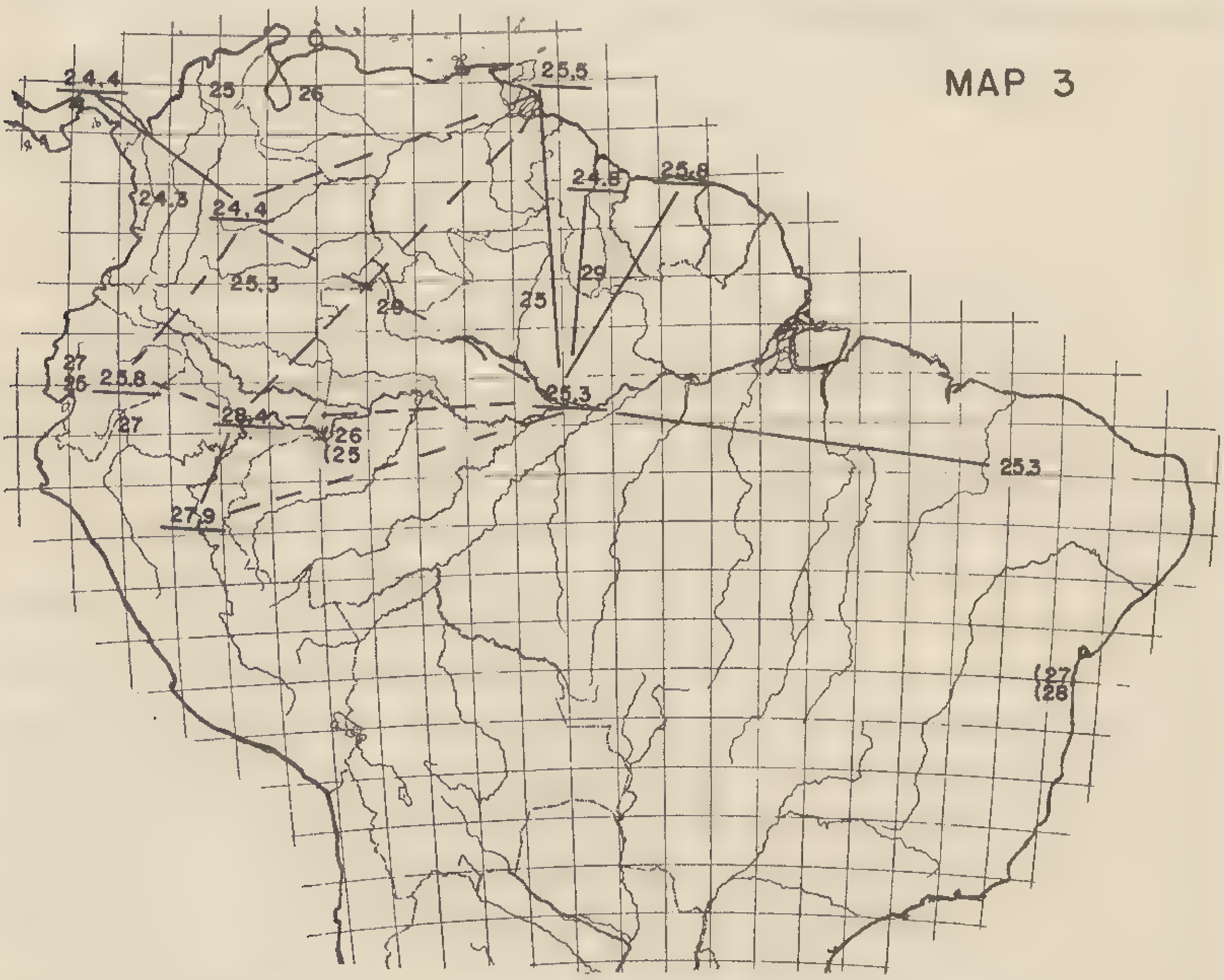
Both the samples from Manaus and from the Ecuadorian Andes differ significantly from the Iquitos and Ucayali samples. Among the remaining samples only one difference is found: that between the series from Colombia and the one from Trinidad. The difference between the Manaus and the Colombian Andes samples approaches the 0.05 level, but does not quite reach it.

The general picture of differentiation of the number of caudal annuli seems to be the following:

A population with high counts occupies the Ucayali River valley up to Iquitos. On the rest of the range there is some variation that does not seem to follow any definite pattern nor to be (with the present material) very extensive. The only break of continuity lies between Colombia and Trinidad. In this island and in the Guianas the values of this variate tend to be higher without reaching the ones found in Peru.

Correlation between number of body and tail annuli

No significant correlations were found between the number of body and of tail annuli, either inside the various samples or (rank correlation) among all of them (Simpson & Roe, 1939).



Map 3. *A. fuliginosa.* Geographic variation of the number of tail annuli See caption under Map 2.

3. Number of segments to a midbody annulus

The number of segments that compose an annulus is usually given as the number of segments between the two lateral sulci, counted above and below these. They constitute useful taxonomic characters, but their determination and analysis are not simple.

A first point to be noticed is the definition of "midbody annulus". This expression has been used rather loosely. Schmidt (1936), feeling the need of a more rigorous definition, used the 100th annulus as the one on which to count the segments. This is decidedly an improvement on the old nomenclature, but it seems to me that such a strict definition of the annulus to be counted is not entirely desirable, due to the fact that there are no regular longitudinal or quincuncial rows of segments in *A. fuliginosa* or any other *Amphisbaena*. The number of segments per annulus is fairly constant for a given section of the trunk, but many irregularities (fusions, splittings or simple discordance of margins of segments) are frequent. It seems to me that the best practice is to count the segments on the hundredth and some adjacent annuli. In a great many cases they will agree. In an appreciable number of instances, however, this will not happen; in such a case the mode of the counts will be taken as the value sought.

It will be seen that all values recorded here are even. The explanation is simple. The variate in question is not really the "number of segments to a midbody annulus", but the "number of segments to a midbody half-annulus". As the amphisbaenians are limbless lizards, we are inclined to forget the bilateral symmetry and treat both sides together as a single unit. This problem has been analyzed by Klauber (1941) for dorsal rows of scales of snakes and I doubt if I could add anything to Klauber's comments.

One of the most useful statistics commonly employed in systematics is the observed range. Non-overlapping of ranges of one or more variables is one of the better criteria for separation of related forms. There is no inconvenience in such a use of the total number of segments as a "key" character. For statistical treatment, however, it is necessary to reduce the data to half-bodies. This is done by assigning to each half-body a frequency of one-half unit. A specimen with both sides equal (as is the case with all in this connection, but not all in the forthcoming case of preanal pores) will contribute one unit to the respective class. Consideration of each half-body as a full unit would unduly increase the number of degrees of freedom.

The data pertaining to dorsal and ventral segments are presented in Tables 8 and 9. Table 9 will do instead of graphs to show the nature of intergradation, for which this character is of little value.

Inspection of these tables and tests of significance of differences between means suggest that the samples from northern British Guiana, Trinidad, Colombian Andes, Panama, Ecuadorian Andes and Iquitos agree very well among themselves. The Ucayali River sample agrees with the Ecuadorian and Iquitos ones in dorsals, but differs in ventrals. All the isolated localities within this territory fit well into the general picture. Manaus differs from Iquitos, Ucayali River, and Colombian Andes. Leticia might be transitional in dorsals but is decidedly Amazonic in ventrals. The two specimens from Vista Alegre and Marudi River may be called intermediate. Paramaribo agrees entirely with Manaus, differing from northern British Guiana in dorsals. One specimen from "Surinam" presents the highest count of dorsals (28); the other one available is a rather low 22.

TABLE 8

Amphisbaena fuliginosa — Number of segments on a mid-body annulus. Distribution of frequencies for all the available material.

	Dorsal					*Ventral*						
Locality	*20*	*22*	*24*	*26*	*28*	*18*	*20*	*22*	*24*	*26*	*28*	*Total*
MANAUS		2	6	2				2	7	1		10
Cucuí	1	2					1	2				3
Villavicencio			3	1					1	3		4
COLOMBIAN ANDES	2	4	2				3	2	3			8
Barranca Bermeja	1							1				1
Rio Frio		1					1					1
Riocito			1							1		1
Chocó		2	1				1		2			3
PANAMA		5	5					6	4			10
Leticia	1		1		1			1	2			3
IQUITOS	2	15	1				1	16	1			18
UCAYALI RIVER	4	6				2	2	6				10
Cenipa River	1	1						2				2
Avila	1							1				1
Santiago River	1							1				1
Luoula	1	1						2				2
ECUADORIAN ANDES	1	6						6	1			7
Bucay		1						1				1
Daule River			1				1					1
Vista Alegre		1							1			1
Marudi River			1					1				1
N. BRITISH GUIANA	1	4	1				1	2	3			6
Surinam		1			1				1	1		2
PARAMARIBO			3	3			3	2	1			6
TRINIDAD	6	7	2			2	6	6	1			15
Pará				1							1	1
Maranhão			1					1				1
Ceará	1	1	1				1		2			3
Santa Maria				3					1	2		3
												127

As for Brasilian specimens, the Santa Maria series agrees with that from Manaus rather than with the samples having low counts. The specimen from Pará has the maximum count, 28. The series from Ceará seems to tend toward low values.

These relationships, as seen in Map 4, seem to follow a pattern in which specimens from the western part of the range present lower counts than those from the eastern.

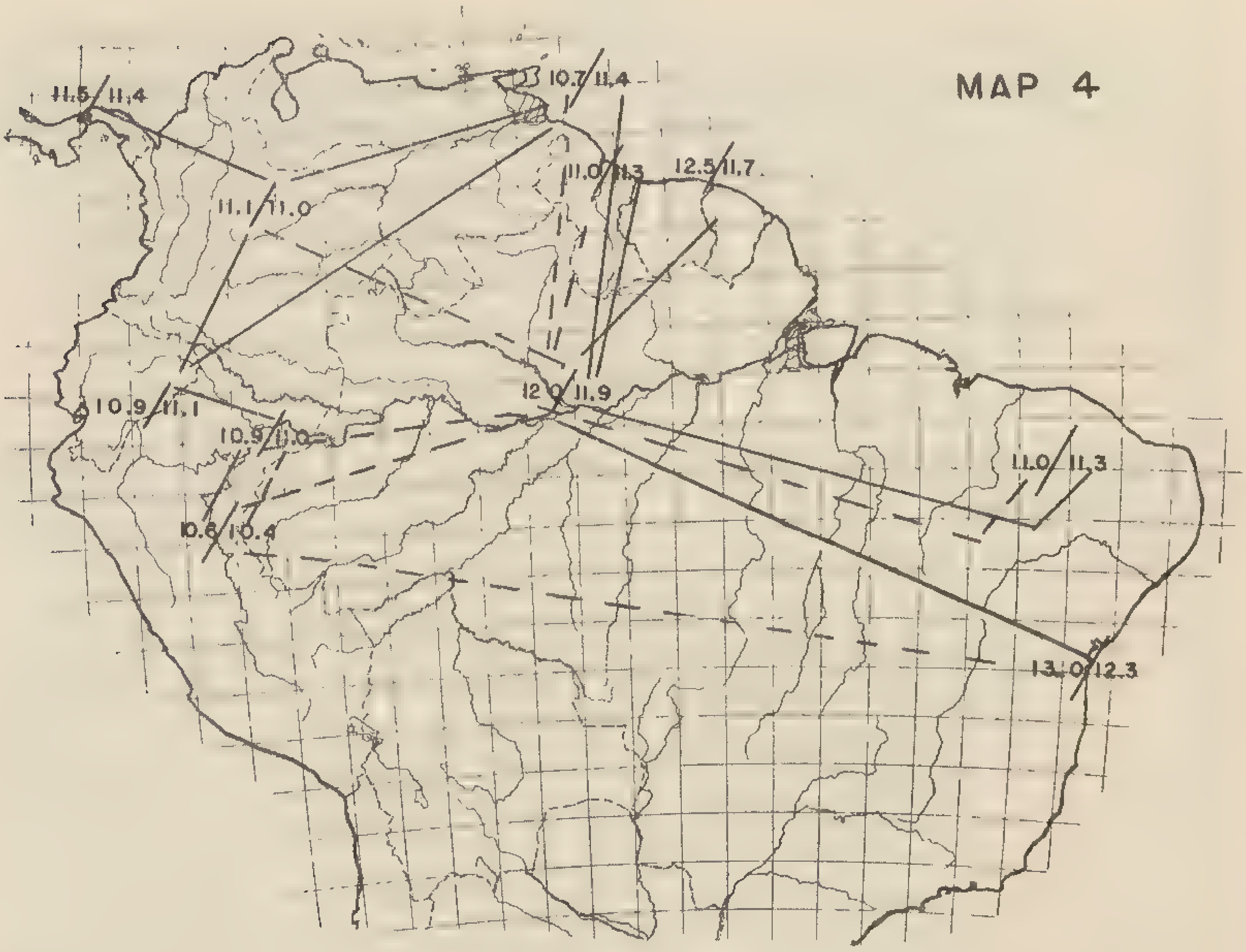
It is interesting to note that in 6 out of 9 samples the means for dorsal and ventral segments differ by 0.2 or less; in 1 sample by 0.3 and in 2 (Panama and Trinidad) by 0.8 and 0.7, respectively.

No correlation between numbers of dorsal and ventral segments was found to be significant within the available samples. No significant rank correlations were found between the two series of means. But, lumping together all the available material, a significant coefficient of correlation of 0.440 was found. This is an interesting situation, but only more material will permit a deeper insight into its cause.

TABLE 9

Amphisbaena fuliginosa — Number of segments on a mid-body annulus in the basic samples.

Locality		*N*	*R*	*M*	σ	*V*
Manaus	Dorsal	10	11–13	12.0±0.21	0.67±0.15	5.6±1.3
	Ventral	10	11–13	11.9±0.18	0.57±0.13	4.8±1.1
Colombian Andes	Dorsal	8	10–13	11.1±0.37	0.99±0.26	8.9±2.2
	Ventral	8	10–12	11.0±0.33	0.95±0.23	8.6±2.2
Panama	Dorsal	10	11–12	11.5±0.17	0.53±0.12	4.6±1.0
	Ventral	10	11–12	11.4±0.16	0.52±0.12	4.6±1.1
Iquitos	Dorsal	18	10–12	10.9±0.10	0.42±0.07	3.9±0.6
	Ventral	18	10–12	11.0±0.08	0.34±0.06	3.1±0.5
Ucayali River	Dorsal	10	10–11	10.6±0.16	0.52±0.12	4.9±1.1
	Ventral	10	9–11	10.4±0.27	0.84±0.19	8.1±1.8
Ecuadorian Andes	Dorsal	7	10–11	10.9±0.16	0.38±0.12	3.5±0.8
	Ventral	7	11–12	11.1±0.16	0.38±0.12	3.4±0.8
N. British Guiana	Dorsal	6	10–12	11.0±0.26	0.63±0.18	5.7±1.7
	Ventral	6	10–12	11.3±0.24	0.82±0.24	7.3±2.1
Paramaribo	Dorsal	6	12–13	12.5±0.22	0.55±0.16	4.4±1.3
	Ventral	6	11–13	11.7±0.33	0.82±0.24	7.0±2.0
Trinidad	Dorsal	15	10–12	10.7±0.18	0.70±0.13	6.5±1.2
	Ventral	15	10–13	11.4±0.21	0.83±0.15	7.3±1.3



Map 4. *A. fuliginosa.* Geographic variation of the number of segments to a mid-body annulus. The 9 basic samples are shown, plus the ones from Sta. Maria and Ceará. The figures to the left of the mark / represent the mean number of dorsal segments; the figures to the right, the mean number of ventral segments. See also caption to Map 2.

4. Number of preanal pores

No evidence of sexual dimorphism was found in this character. This does not mean the results obtained were decisive evidence of sexual homogeneity in pore number. It only means that the present data, admittedly insufficient for such an analysis, do not indicate the presence of sexual dimorphism. As sexual differences were found in no other character, this reasoning must be extended to all the cases. The sex is not easy to ascertain in the larger species of *Amphisbaena,* and I expect my percentages of females to be a little higher than the true population values.

As in the case of segments to a midbody annulus, it is more exact to consider the preanal pores separately for the two sides. In this instance again the range is of taxonomic importance and no inconvenience is found in the use of the range and modal value as the only data provided in keys or differential diagnoses. The addition of other statistics would even be cumbersome and of little value.

The small number of classes and discrete variation would perhaps favor the use of qualitative statistical methods for this variate. The small number of individuals in the extreme classes, however, proves bothersome to such tests and it was thought better to follow the methods used before.

Table 10 shows an overall picture of the variation of this character. The respective means and standard-errors are presented in Table 11.

TABLE 10

Amphisbaena fuliginosa — Number of preanal pores. Distribution of frequencies in all the available material.

Locality	*Preanal pores*					*Total*
	6	*7*	*8*	*9*	*10*	
MANAUS			9	1		10
Cucuí	1		2			3
Villavicencio			3	1		4
COLOMBIAN ANDES	3	2	2			7
Barranca Bermeja			1			1
Rio Frio		1				1
Riocito			1			1
Chocó	2		1			3
PANAMA			6	4		10
Leticia			2		1	3
IQUITOS	1		17			18
UCAYALI RIVER		3	7			10
Cenipa River		1	1			2
Pastaza River			1			1
Avila			1			1
Santiago River			1			1
Luoula			1	1		2
ECUADORIAN ANDES		1	5	1		7
Bucay		1				1
Daule River			1			1
Vista Alegre			1			1
Marudi River			1			1
N. BRITISH GUIANA			4	2		6
Surinam			2	1		3
PARAMARIBO			4	1	1	6
TRINIDAD	6	2	8			16
Pará			1			1
Maranhão			1			1
Ceará			2		1	3
Santa Maria			1	1	1	3
Total						128

The samples from the Colombian Andes and Trinidad agree with each other, but differ significantly from all the remainder. No other significant differences were found, although the southwestern samples seem to tend toward lower values than the northern ones.

As to the scattered material, Cucuí and Villavicencio seem to be intermediate between Manaus and Colombia. All the rest of the material agrees with the samples from adjacent areas.

TABLE 11

Amphisbaena fuliginosa — Number of preanal pores. Means of the basic samples.

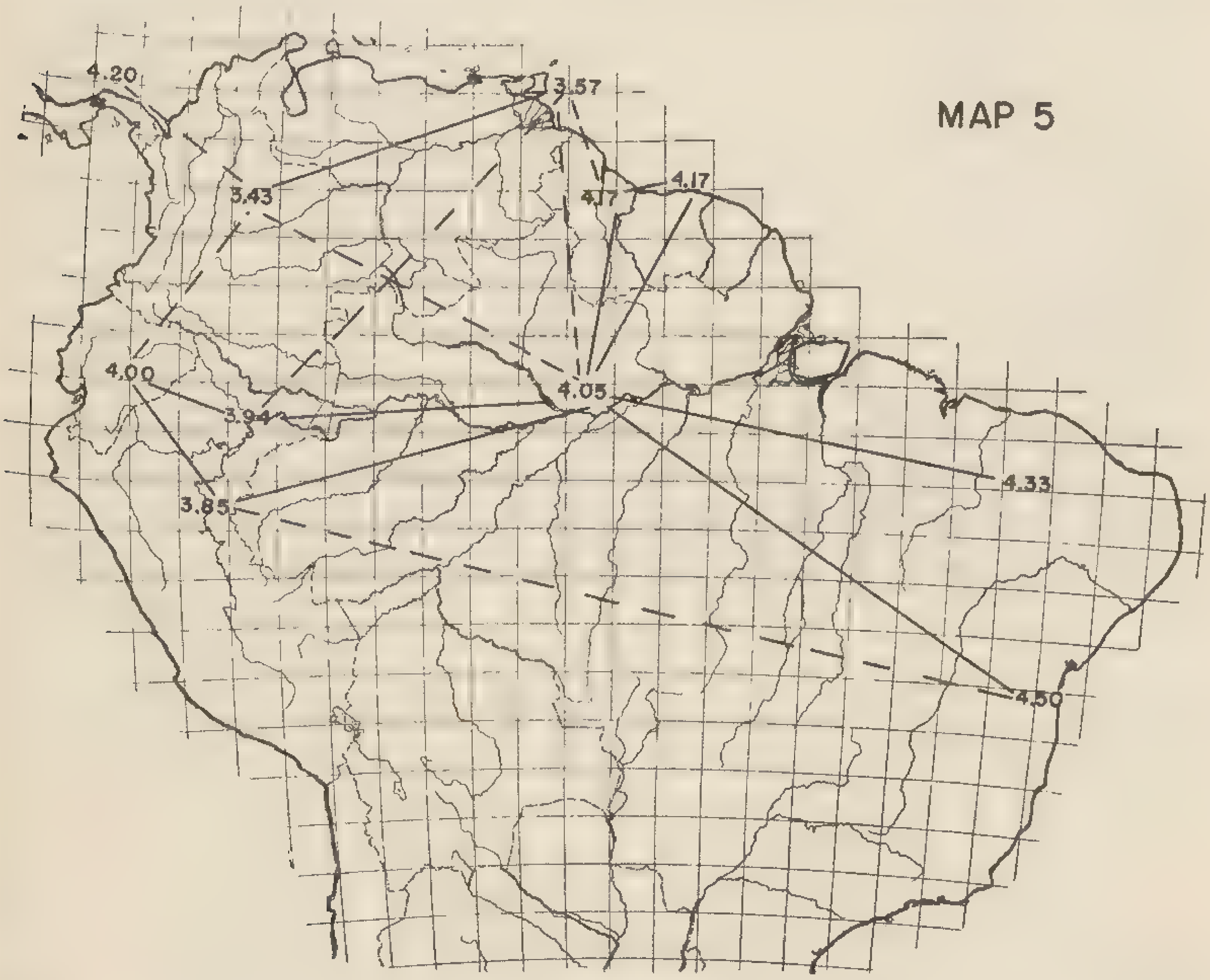
Locality	*N*	*M*
Manaus	10	4.05 ± 0.11
Colombian Andes	7	3.43 ± 0.20
Panama	10	4.20 ± 0.13
Iquitos	18	3.94 ± 0.55
Ucayali River	10	3.85 ± 0.11
Ecuadorian Andes	7	4.00 ± 0.15
N. British Guiana	6	4.17 ± 0.14
Paramaribo	6	4.17 ± 0.14
Trinidad	16	3.57 ± 0.13

The general picture with reference to preanal pore counts seems to be one of a widespread population with a range of 7–10 pores, but with a heavy concentration on 8. Within this population we find another one, presumably continuous, occupying Colombia and Venezuela to Trinidad.

5. Relative tail length

The study of body proportions has received in recent years a great impetus, chiefly since Huxley and Teissier's first studies on allometric curves. Unfortunately, most of the studies published using this and other methods lack a more precise statistical treatment, a fact that reduces their usefulness to a minimum. Klauber (1938, 1943) has published extremely important papers on the subject of body proportions in snakes and the methods of his 1943 paper are here applied without change to *Amphisbaena*, a limbless lizard.

The measurement of museum specimens of *Amphisbaena*, especially the bulkier species, is not very easy. The body is usually twisted and the bends are hard to straighten out. Best results were obtained by me with a flexible ruler. The body length is measured along the ventral midline, from snout to vent; the tail length also, preferably ventrally from vent to a plane that passes tangentially to the tail tip. The body lengths were recorded to the nearest 5 mm; the tail lengths to the nearest 1 mm (Simpson & Roe, 1939: 19–33). Perfect consistency is rarely obtained for body length; the data here presented are means of 3 measurements, differing usually by 5% to 10%. Tail length is not hard to measure, and consistency is usually easy to obtain. The specimens were shuffled and measured without reference to locality data, to avoid bias. In plotting the points, the less closely fitting ones were checked; no reason for change was seen in more than 90% of the cases; the few mistakes were made in copying.



Map 5. *A. fuliginosa.* Geographic variation of the number of preanal pores. Averages of the basic samples shown. See also caption to Map 2.

Several of the samples were too small for a reliable fit. When possible these were enlarged by adding the specimens from adjacent territories shown not to differ from them in other characters. Sample "Colombian Andes" was replaced by sample "Colombia", which included, besides the former, the specimens from Barranca Bermeja, Rio Frio, Riocito and the Chocó. Sample "Ecuadorian Andes" including the material from Bucay, Daule River and Luoula became sample "Ecuador". Sample "Paramaribo" including 3 specimens from Surinam became sample "Dutch Guiana". The remainder were not altered.

The regression of tail length on body length seems to obey a linear relationship in *A. fuliginosa.* In *A. alba* and *A. darwinii darwinii* (Vanzolini, in press) I found a curve with an upper plateau, closely resembling a Gompertz curve. This is most probably due to lack of correlation in adult age. During the period of growth the two variables appear to be correlated because both present a strong correlation with age. Since one of them stops growing, the curve changes character and when both reach ultimate size, the curve assumes the form of a straight line parallel to the axis of the x (form of the regression line when $r = 0$). The concordance of these successive stages gives the resulting curve the appearance of a saturation curve, which is theoretically baseless.

In the present case one or two samples seem to show a tendency in the same direction. Since exclusion of the suspected specimens did not change appreciably the slope, a straight line was fitted to all the specimens by the least squares method (Fisher, 1948; **5**, 26). Goodness of fit was tested by means of analysis of variance. Allometric curves showed no better and, in almost all cases, worse fits, and so were rejected.

TABLE 12

Amphisbaena fuliginosa — Data on the linear regression of tail length on body length for the basic samples.

Locality	N	a	b	$Sy.x$	r
Manaus	9	4.35	0.114	2.62	0.93
Colombia	13	2.24	0.142	2.20	0.97
Panama	5	0.76	0.145	0.50	0.996
Iquitos	15	0.62	0.170	4.06	0.88
Ucayali River	9	− 2.62	0.173	2.75	0.97
Ecuador	8	− 6.25	0.177	3.59	0.93
N. British Guiana	5	6.92	0.113	2.84	0.98
Dutch Guiana	6	2.98	0.138	2.30	0.990
Trinidad	13	−16.03	0.217	1.49	0.97

The data pertaining to the graduated lines are presented in Table 12. In this table

N	is the number of individuals in the samples;
a, b	are the terms of the linear equation $y' = a + bx$ in which x is the body length and y' the calculated tail length;
$s_{y.x}$	is the standard error of estimate and
r	is the coefficient of linear correlation (Simpson & Roe, 1939).

Perusal of this table shows that the samples may be separated into four groups, according to the slope (*b*):

1. Northern British Guiana	b = 0.113
Manaus	0.114
2. Colombia	0.142
Panama	0.145
Dutch Guiana	0.138
3. Iquitos	0.170
Ucayali River	0.173
Ecuador	0.177
4. Trinidad	0.217

Testing the significance of differences between various pairs of coefficients (Fisher, 1948: 5, 27), we find the only consistent differences to be those between Trinidad and the first two groups. This would rob this grouping of its significance; further analysis, however, shows that this is unnecessary.

There is, as Klauber points out (1943: 40) no point in comparing the regression constants *a* for different samples. The real interest lies in the comparison of tail length at various moments of life, as expressed by suitable body lengths. To obtain the desired standard body lengths, let us inspect Table 13.

TABLE 13

Amphisbaena fuliginosa — Body- and tail length of smallest and largest specimens in the basic samples.

Locality	*Smallest*	*Largest*
Manaus	152+x 170+21	330+40*
Colombia	115+19	405+58**
Panama	240+36	350+52
Iquitos	245+39	450+75
Ucayali River	105+16	365+62
Ecuador	200+x 220+34	380+64
N. British Guiana	195+29	420+55
Dutch Guiana	135+21	370+x 350+51
Trinidad	195+25	310+x 280±42
*Cucuí		390+x
Leticia		340+x
**Villavicencio		440+x

Looking for the length at birth, we see that the smallest specimens recorded measure 105 mm and 115 mm. There is one specimen from Paramaribo measuring 90 mm, but this has not been included because it has an abnormally low number of body annuli, being, in all probability, a non-viable juvenile. So the length of 110 mm was taken as representing the first stage in the life history of *A. fuliginosa*. Several samples do not include any specimen even approaching this size, but I think it is relatively safe to assume that the extent of variability at birth will not be so large as to invalidate these comparisons.

For the adult size, we find the longest specimen to be one measuring 450 mm from snout to vent. Three samples have specimens exceeding 400 mm: Iquitos, British Guiana and Colombia. The remainder, however, excepting that from Trinidad, present values above 350 mm. So body lengths of 350 mm and 400 mm were chosen to test differences in full grown adults.

In an effort to compare individuals still growing but already presumably in reproductive age, one further standard length, 250 mm, was introduced.

Tail lengths at those standard body lengths are set forth in Table 14.

TABLE 14

Amphisbaena fuliginosa — Tail length at certain body lengths, as calculated from the regression line, in the basic samples.

Locality	*Body length — mm*			
	110	*250*	*350*	*400*
Manaus	16.9	32.8	44.2	50.0
Colombia	17.9	37.7	51.9	59.0
Panama	16.7	37.0	51.5	58.8
Iquitos	19.3	43.1	60.1	68.6
Ucayali River	16.5	40.7	58.0	66.7
Ecuador	13.2	38.0	55.7	64.5
N. British Guiana	19.4	35.2	46.5	52.1
Dutch Guiana	18.2	37.5	51.3	58.2
Trinidad	7.8	38.2	59.9	70.8

The first type of comparison to be made is between samples belonging to the same group of *b* values. These comparisons are shown in Table 15.

TABLE 15

Amphisbaena fuliginosa — Comparison of tail lengths at standard body lengths in different pairs of samples having similar values of the coefficient of regression *b*.

Pairs of samples	*Body length — mm.*			
	110	*250*	*350*	*400*
Manaus (0.114) N. British Guiana (0.113)	+++	–	–	–
Colombia (0.142) Panama (0.145)	+++	–	–	–
Colombia (0.142) Dutch Guiana (0.138)	–	–	–	–
Panama (0.145) Dutch Guiana (0.138)	++	–	–	–
Iquitos (0.170) Ucayali River (0.173)	++++	–	–	–
Iquitos (0.170) Ecuador (0.177)	++++	++++	+	–
Ucayali River (0.173) Ecuador (0.177)	++++	–	–	–

In this and similar tables

—	means a probability larger than 0.05 of the differences being due to random fluctuations;
+	probabilities equal to or smaller than 0.05 and larger than 0.02;
+ +	probabilities equal to or smaller than 0.02 and larger than 0.01;
+ + +	probabilities equal to or smaller than 0.01 and larger than 0.001;
+ + + +	probabilities equal to or smaller than 0.001.

Although all pairs but one differ at birth, it is obvious that they converge toward the same tail length at adult age.

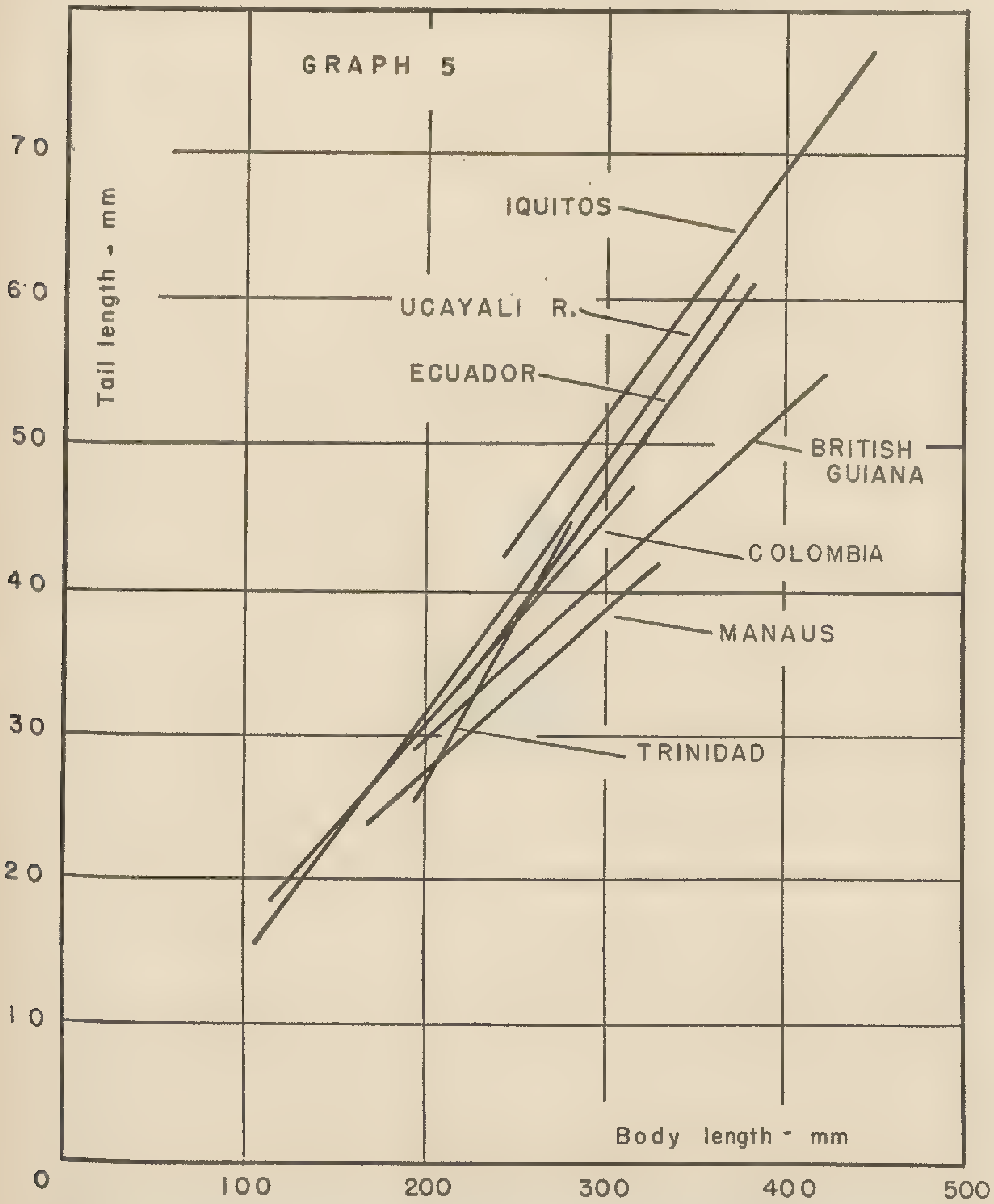
Comparing samples belonging to different groups of *b* values (Table 16) we see that the situation here is different. Differences arise where they did not exist at birth, or remain significant when they were so at birth. The only, and very interesting, convergence is that between Trinidad and Iquitos (naturally repeated for Trinidad and Ucayali and Ecuador). This tends to show that the differences in *b* really have no significance in this case. It should be added that the values for young specimens from Trinidad (extrapolated, as the smallest observed measures 195 mm body length) are so small that it is to be expected that the finding of newly born individuals will change either the slope or the form of the regression curve.

TABLE 16

Amphisbaena fuliginosa — Comparison of tail lengths at standard body lengths in different pairs of samples having dissimilar values of the regression coefficient *b*.

Pairs of samples	*Body length — mm.*			
	110	*250*	*350*	*400*
Manaus (0.114) Colombia (0.142)	+	++++	++++	++++
Manaus (0.114) Iquitos (0.170)	++++	++++	++++	++++
Manaus (0.114) Trinidad (0.217)	++++	++++	++++	++++
Manaus (0.114) Dutch Guiana (0.138)	++	++++	++++	++++
N. British Guiana (0.113) Trinidad (0.217)	++++	+++	++++	++++
N. British Guiana (0.113) Dutch Guiana (0.138)	–	–	+	+++
Colombia (0.142) Trinidad (0.217)	++++	–	++++	++++
Colombia (0.142) N. British Guiana (0.113)	++	+	+++	++++
Trinidad (0.217) Iquitos (0.170)	++++	++++	–	–

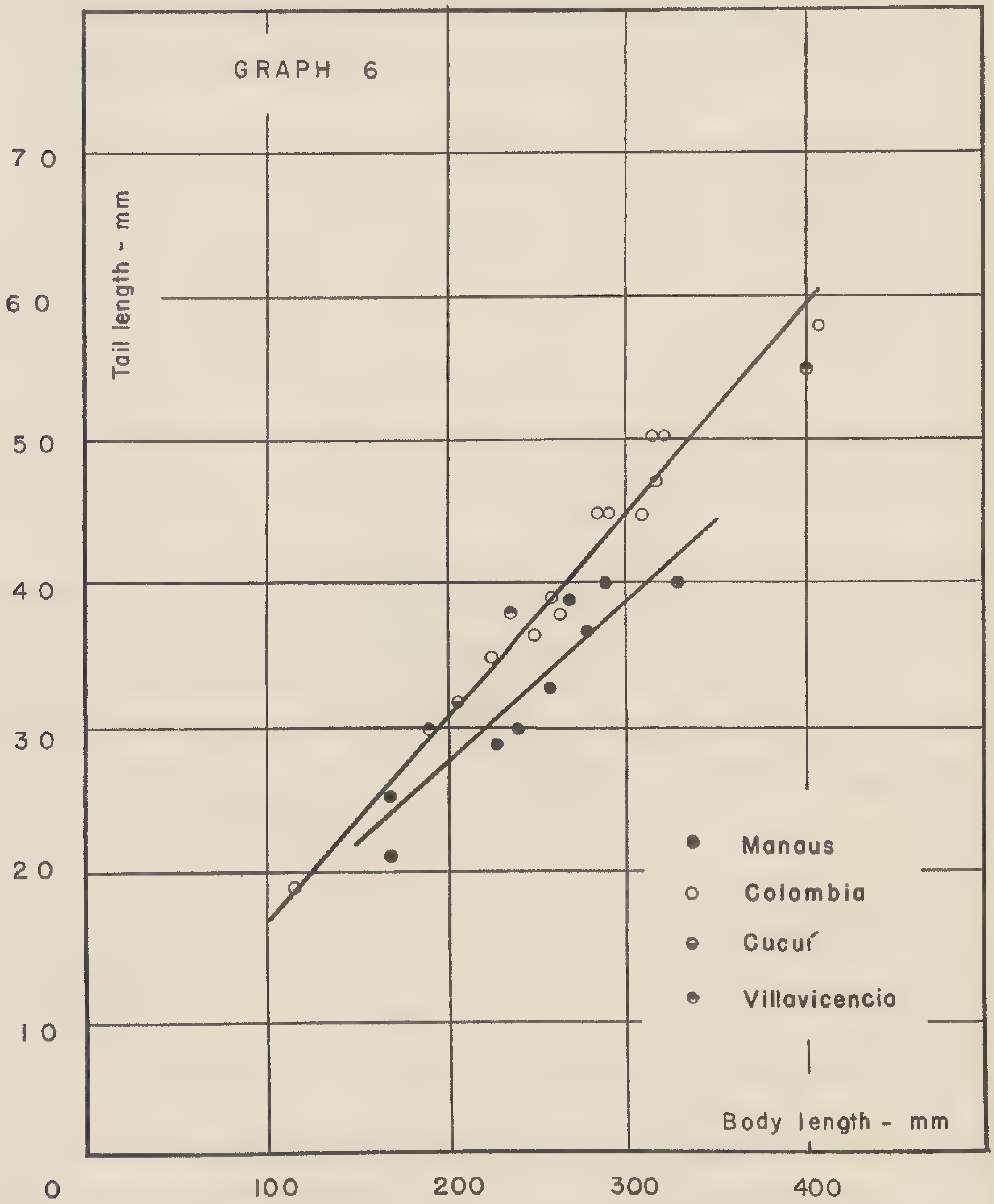
Turning now to the geographical features of the variation in tail length, we see that the Iquitos-Ucayali assemblage constitutes a fairly natural group. The relationship of Trinidad to this group may be explained in one of two ways: either all belong to the same population of tail lengths (which would occupy a large belt separating Manaus-British Guiana from Colombia-Panama) or we are facing a case of parallelism. It will be seen that the former hypothesis seems more likely to be true.



Graph 5. *A. fuliginosa.* Linear regression of tail length on body length for the fundamental samples. Samples from Panama and Dutch Guiana omitted on account of overlapping almost completely with Colombian sample.

The Manaus-British Guiana group and the Colombia-Panama ones are also very natural. Dutch Guiana, resembling the latter, must be a case of parallelism.

Graph 5 shows pictorially the relationships between these groups. Panama and Dutch Guiana are omitted because they virtually overlap Colombia.

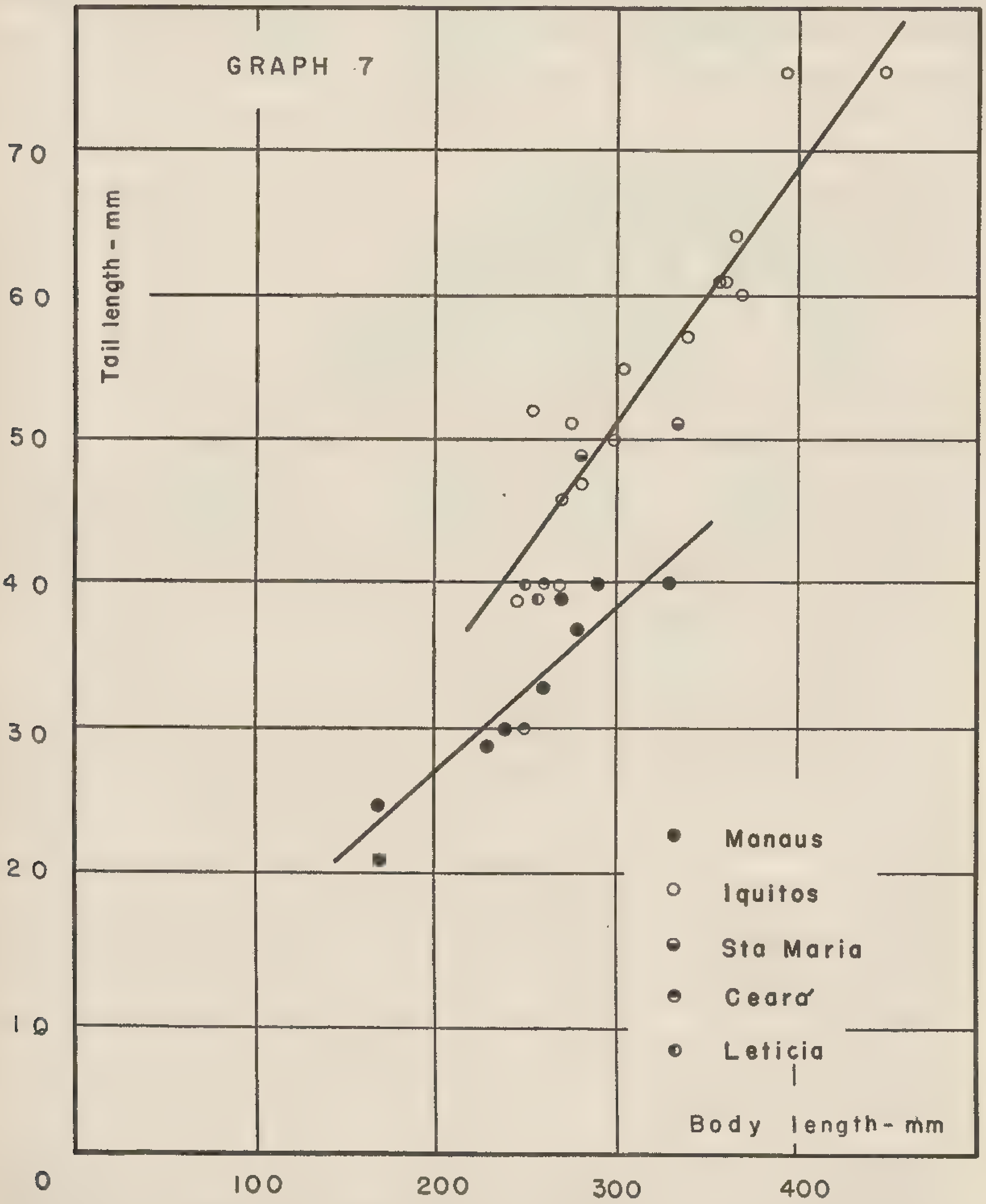


Graph 6. *A. fuliginosa.* Linear regression of tail length on body length in the samples from Manaus and Colombian Andes, showing actual points for visual evaluation of goodness of fit and comparison of specimens from intervening territory.

Considering now the specimens not included in the above discussion, we find that Cucuí and Villavicencio tend strongly toward the Colombian side (Graph 6) instead of the Amazonian.

Leticia (Graph 7) shows a position really intermediate between Manaus and Iquitos. A similar relationship exists in the case of Vista Alegre and Marudi River, between Manaus and British Guiana.

The material from eastern Brasil (Santa Maria) shows decided dis-

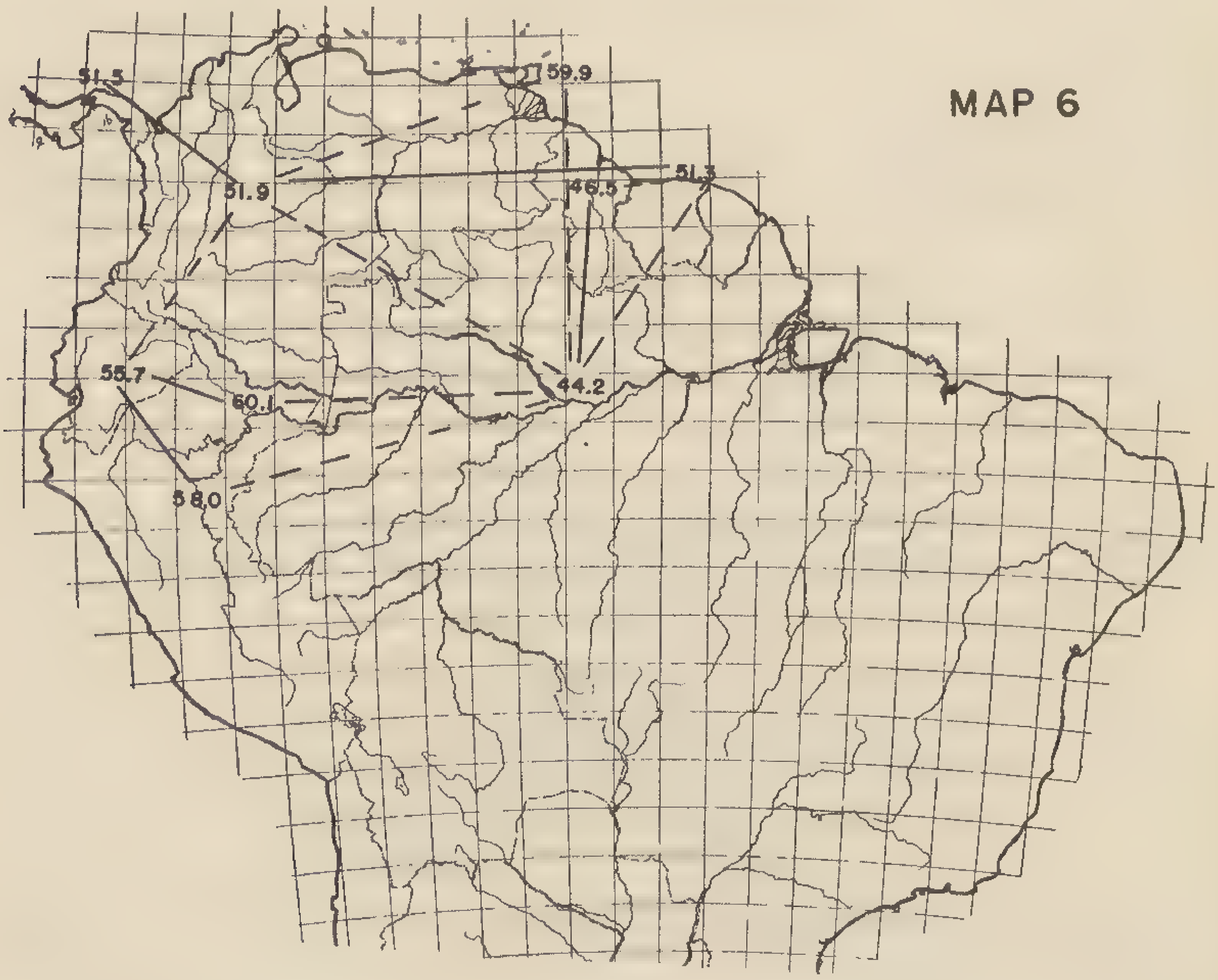


Graph 7. *A. fuliginosa.* Linear regression of tail length on body length in the samples from Manaus and Iquitos, showing actual points for visual evaluation of goodness of fit and comparison of specimens from other localities.

agreement with that from Manaus, once more. This does not happen in the case of Ceará (Graph 7).

Thus the general picture of tail length differentiation seems to be the following:

A short-tailed population is present in the Amazon valley and British Guiana. Long-tailed populations are present in the region from the Ucayali River and Iquitos up to the Pacific coast of Ecuador and Trinidad. Populations with intermediate values are found in Dutch Guiana and Colombia and Panama. The differences considered are present in adult specimens, measuring 250 mm or more.



Map 6. *A. fuliginosa.* Geographic variation of the tail length at standard body length 350 mm. Values for the basic samples shown. See also caption to Map 2.

6. Color

The characteristic and unmistakable color pattern of *A. fuliginosa,* described by Linné in the Systema Naturae as "alba, ex atro fusco varia, capite immaculato" and by Boulenger (1885: 438) as "Black and white, either the one or the other color predominating" can be reduced to four elements that seem to vary with a certain degree of independence in the material examined.

These elements are:

a. the ground color;
b. the spotting of the head;
c. the dorsal pattern and
d. the ventral pattern.

In the following discussion the color patterns will be considered as seen in not badly faded alcoholic specimens. I believe that the utility of taxonomic characters only observable in live or freshly killed animals is limited to giving more authority, by positive correlation, to other characters observed in regularly preserved museum specimens.

The ground color of *A. fuliginosa* shows two extremes: a very light, whitish yellow (figs. 2, 3, 4, 7, 9, 10, 11) and a dirty, grayish pink (figs. 5, 6, 8). On the first type the dark spots have precise margins; on the second the spots are rather smudgy, especially on the head. Difference between the two phases can be judged by comparison of figs. 7 and 8, of two specimens from Riobamba, Ecuador.

TABLE 17

Amphisbaena fuliginosa — Number of specimens with different ground colors in several samples.

Locality	*Ground color*			
	Yellow	*Intermediate*	*Dirty pinkish*	*Total*
Panama	—	—	10	10
Colombia	1	3	10	14
Trinidad	4	12	—	16
N. British Guiana	6	—	—	6
Villavicencio	—	1	3	4
Cucuí	1	2	—	3
Manaus	10	—	—	10
Ecuadorian Andes	4	2	1	7
Daule River	—	—	1	1
Bucay	—	—	1	1
Luoula	2	—	—	2
Santiago River	1	—	—	1
Avila	1	—	—	1
Pastaza River	1	—	—	1
Cenipa River	1	—	—	1
Iquitos	18	—	—	18
Ucayali River	10	—	—	10

The yellow ground color is the only one found in Brasil, the Upper Amazon and the Guianas. Conversely, the smudgy phase is the only one found in Panama. In Colombia we have almost complete predominance of the smudgy form; in Trinidad and Ecuador the composition of the samples is transitional (Table 17).

The smudgy form presents very little variation of the remaining color elements. The head spots are generally multiple, small, with rather indistinct margins. The belly has usually the same amount of black as the dorsum. When the head is sparsely spotted, it presents a characteristically dirty pinkish color. (fig. 5).

In the yellow form we have considerable variation of the rest of the pattern.

The head varies from immaculate to heavily spotted. In Manaus immaculate heads are found almost exclusively. In Paramaribo the heads are a little more spotted. In British Guiana there is a majority of spotted heads and the same holds true for Trinidad. In Iquitos the proportion of spotted heads is also very high, much more so than in the Ucayali. The Ecuadorian material agrees rather with the latter. In the Brasilian samples only one spotted head (with a single very small spot) was found. These data are summarized in Table 18.

TABLE 18

Amphisbaena fuliginosa — Number of specimens with immaculate and spotted heads in several samples.

Locality	*Head pattern*		
	Immaculate	*Spotted*	*Total*
Manaus	9	1	10
Leticia	–	3	3
Iquitos	2	16	18
Ucayali River	5	5	10
Ecuador	4	3	7
Vista Alegre	1	–	1
Marudi River	–	1	1
N. British Guiana	1	5	6
Trinidad	1	15	16
Paramaribo	4	2	6
Ceará	2	1	3
Santa Maria	2	1	3

Analysis permits us to conclude that among the population with a clear yellowish ground color a differentiation in color pattern is found. A form with very little spotting is found from Manaus east and south to Baía. In the rest of the territory there is a variable but always large amount of head spotting.

The dorsal pattern presents a very interesting variation. A minimum amount of black is found in Iquitos, Ucayali River and some of the Ecuadorian specimens (the ones with the yellow ground color). The dorsal spots here form narrow, irregular, transverse bands, prolonged down the flanks to the sides but not across the abdomen, which is lighter than the back (figs. 7, 11).

In Manaus, Dutch Guiana, British Guiana and, partially, Trinidad the dark spotting is much heavier, with a tendency in the Guianas to a "polka dot" pattern, with yellowish dots on a black or very dark brown dorsum. Here also the abdominal pattern is much lighter. (figs. 2, 3, 4).

The most melanistic form is that found in Santa Maria. Here even the abdomen is almost completely dark. The Ceará specimens are similar to the Manaus - Guianas ones, but for one (IB 681 A) that could be mistaken for one of those from Santa Maria.

Integrating these data into a general pattern we find:

In Panama and Colombia there is a form with a dirty pinkish ground color and smudgy darker spots evenly distributed on back and belly (figs. 5, 6).

In Manaus we find a form with a very light yellow ground color, the head immaculate, the body with dark spots having very distinct margins, more concentrated in the front part of the dorsum and much scarcer on the abdomen. Intergradation between these two forms is found in Cucuí and Villavicencio. These intergrades present either an intermediate ground color or a very definite Colombian pattern; only one of them has an immaculate head.

In Dutch Guiana (fig. 2) we find a form much like the Manaus one; the most sensible difference is the larger amount of spotted heads.

In British Guiana a form is found with an even larger proportion of spotted heads. In Trinidad there is definite evidence of intergradation between populations in British Guiana and Colombia. The ground color is decidedly intermediate but the spots are not smudgy: they tend to the pattern found in British Guiana. Another intergrade is the Riocito specimen.

In Leticia we find the Manaus form intergrading with another one (fig. 11) that occupies the Ucayali River valley up to Iquitos. Here there is the same spotting of the head seen in the sample from British Guiana, although the proportions differ. The ground color is the same.

But the dorsal pattern is different, with a tendency toward reduction of the amount of black and formation of narrow irregular transverse bands; the abdomen is much lighter. This form intergrades with the Colombian one in Ecuador. The Upper Amazonian specimens, up to the foothills of the Andes, agree entirely with the lowland material. In Riobamba (figs. 7, 8) one specimen clearly belongs to the Colombian form and two are somewhat intermediate.

Finally we find in Santa Maria a very distinctive form (figs. 9, 10) with yellow ground color and with the dorsum and abdomen almost solidly dark.

Geographical differentiation: synthesis

After presenting detailed accounts of the variation of single characters in the territory studied, let us try to take a panoramic view of the geographic differentiation of *A. fuliginosa*. This problem presents two aspects: (a) the analysis of the total similarity and divergence among the several samples; (b) the feasibility of identifying single specimens.

With regard to the first aspect, the question that at once arises is one of method. Klauber (1943 a) has discussed the problem with his usual thoroughness and ability. In this case, however, very little advantage would result from the application of his methods; the best understanding of the situation seems to me to result from the consideration of the data presented above with no further elaboration.

In the series of small tables presented below a plus sign implies a statistically significant difference; a minus sign a not significant one.

No two samples agree in all characters. This is by no means a novel observation, as pointed out by Mayr (1947: 34) and Simpson (1947: 201), but its bearing on strictly taxonomic (or rather nomenclatorial) problems has been somewhat underestimated by herpetologists, leading to the erection of what seems to me a larger number of new names than the small amount of evidence warrants.

The best agreement between samples is found between Colombia and Panama (Table 19). They agree very closely in number of body and tail annuli, dorsal and ventral segments, tail length at adult size and general color pattern. The only difference is in the number of preanal pores. In this character the means are uniform throughout the range, with the exception only of Colombia and Trinidad. This is a common phenomenon and more logically to be expected than concomitant variation of all characters.

Turning now to a consideration of the relationships of the Colombian material to the neighboring samples, it is pertinent to note in the first

TABLE 19

Amphisbaena fuliginosa — Summary of the differences between the sample from the Colombian Andes and several others.

Characters	*Samples*			
	Panama	*Trinidad*	*Ecuadorian Andes*	*Manaus*
Body annuli	−	+	+	+
Tail annuli	−	+	+	+
Dorsal segments	−	−	−	+
Ventral segments	−	−	−	+
Preanal pores	+	−	+	+
Tail length at body length 400 mm	−	+	+	+
Color	−	±	±	+

place the homogeneity of all the Colombian specimens, excluding only Villavicencio and including the Venezuelan locality of Riocito.

Taking Trinidad first (Table 19) we see agreement in the number of dorsal and ventral segments and in the number of preanal pores. The number of segments has no great significance in this case, as a glance at Map 3 shows immediately. The number of pores is important, because it is a strikingly aberrant character shared only by these two samples from adjoining regions. On the other hand, in number of tail annuli the difference between Colombia and Trinidad is significant. In number of body and tail annuli the Trinidad sample agrees with that from northern British Guiana; in number of pores and color it is intermediate. The three samples disagree in relative tail length.

If we take the material from Trinidad to represent the adjacent mainland, we can conclude that between British Guianan and Colombian material there is a difference of subspecific rank and that intergradation occurs in Venezuela. Investigations of this intergradation and of the real relationships between the forms inhabiting the continent and Trinidad are among the most interesting to be undertaken when adequate material is available.

Let us compare now the Colombian material with the Ecuadorian and Upper Amazonian samples. It is easy to see that the differences between Colombia and Iquitos are numerous and sharp. The only agreement is in the rather unimportant matter of segments, which do not vary in the occidental part of the range. Ecuador is a region of intergradation, where we find either intermediate specimens or examples attributable to each of the two forms living side by side.

To complete the analysis of this Colombian subspecies, the differences between Colombia and Manaus remain to be examined. These differences are highly significant for all characters. Furthermore, the small samples from Cucuí and Villavicencio show intergradation, and I believe it to be safe to conclude that one subspecies of *Amphisbaena fuliginosa* occupies the highlands of Colombia, reaching the Pacific Ocean to the West, the Isthmus of Panama and the northwest coast of Venezuela to the north. The hardest problem connected with this form (besides intergradation in Venezuela) is the feature of intergradation in the region north of Iquitos and south of Villavicencio.

TABLE 20

Amphisbaena fuliginosa — Summary of the differences between the sample from the Ucayali River and several others.

Characters	*Samples*		
	Iquitos	*Ecuadorian Andes*	*Manaus*
Body annuli	+	+	+
Tail annuli	−	+	+
Dorsal segments	−	−	+
Ventral segments	+	+	+
Preanal pores	−	−	−
Tail length at body length 400 mm.	−	−	+
Color	−	±	−

The Ucayali River valley and the Iquitos samples present almost the same degree of agreement as the Colombian and Panamanian ones (Table 20). Disagreement here is with respect to two characters: number of body annuli and number of ventral segments. The difference in number of ventral segments has probably the same meaning as in number of pores in Colombia and Trinidad samples. The difference in number of body annuli, however, has a more important meaning. The Iquitos sample is intermediate between that from the Ucayali and that from Ecuador, but not that from Manaus. The Leticia sample, geographically closer to Iquitos, agrees more with the sample from Manaus and does not even approach the values found in Iquitos (see

Map 2). Rather peculiar also is the circumstance that in tail annuli and tail length Iquitos presents higher values than Manaus, Ecuador, Ucayali River and Colombia. These puzzling features seem to be due to local differentiation coupled with subspecific hybridization.

The differences between Manaus and Iquitos are decidedly significant (Table 21).

We may then safely conclude that a subspecies of *A. fuliginosa* occupies the Ucayali River valley up to Iquitos on the Amazon, intergrading in Ecuador with the Colombian subspecies and in the Leticia region with a middle Amazonic subspecies. As has already been noted, critical material for the understanding of this form must be collected in the region to the north of Iquitos, east of the Ucayali (region of the rivers Javarí, Juruá and Purús) and down the Amazon to Manaus.

TABLE 21

Amphisbaena fuliginosa — Summary of the differences between the sample from Manaus and several others.

Characters	*Samples*		
	Iquitos	*British Guiana*	*Dutch Guiana*
Body annuli	+	+	+
Tail annuli	+	–	–
Dorsal segments	+	+	–
Ventral segments	+	–	–
Preanal pores	–	–	–
Tail length at body length 400 mm.	+	–	+
Color	–	–	–

Turning now to the northern coast of South America, we have already discussed the relationships among Colombia, Trinidad and British Guiana. Lack of Venezuelan material makes it inadvisable to compare Trinidad with Manaus, but a comparison must be made between the latter and the British Guianan material (Table 22).

The chief differences between the above mentioned samples are in color and number of body annuli. Agreement is present in number of tail annuli and proportional tail length. Inasmuch as Manaus presents a very homogeneous and distinct sample, I think it wise to separate the British Guianan population subspecifically from the middle Amazonian one. The upper Branco River is in all probability the zone of intergradation, as indicated by the specimens from Marudi River and Vista Alegre.

The Dutch Guiana population should, at least for the time being, be included in this British Guianan subspecies. Its relationships to Manaus in dorsal segments and color tend to show that its differentiation has been achieved in a probably independent way from British Guiana populations. The same is indicated by the sharp differentiation in tail length.

The paucity of material, however, makes it wiser to keep the populations of Dutch Guiana, British Guiana and Trinidad lumped under one subspecific name. Collection of more material, especially from Venezuela, French Guiana and Pará, will eventually modify this *status quo*, but it seems to me better to split in the future a composite form than to risk the addition of new synonyms to an already overburdened taxonomy.

TABLE 22

Amphisbaena fuliginosa — Summary of the differences between the sample from British Guiana and the remaining samples from northern South America.

Characters	*Samples*	
	Trinidad	*Dutch Guiana*
Body annuli	−	−
Tail annuli	−	−
Dorsal segments	−	−
Ventral segments	−	−
Preanal pores	+	−
Tail length at body length 400 mm.	+	+
Color	±	−

The small sample from the State of Ceará agrees rather well with the Manaus sample, but shows a tendency toward a lower number of body annuli and toward the type of coloration found in Santa Maria. So we may include this region in the area occupied by the middle Amazonian population, keeping in mind a probable intergradation with an eastern Brasilian form.

This eastern Brasilian form is represented by the three specimens from Santa Maria.

It is curious and sad that these three specimens, the only ones known from the region, as far as I am informed, were collected by Maximilian

TABLE 23

Synopsis of the races of *A. fuliginosa*

	fuliginosa	*amazonica*	*varia*	*bassleri*	*wiedi*
Body annuli	196–213	207–221	190–205	204–215	197–206
Tail annuli	24–28	24–27	23–27	26–30	24–28
Segments on a mid-body annulus	20–28/20–28	22–26/22–26	20–26/20–26	20–22/18–24	26/24–26
Pores	6–10	8–9	6–9	6–8	8–10
Ground color	Yellow	Yellow	Dirty pinkish	Yellow	Yellow
Head	Immaculate or spotted	Immaculate (rarely spotted)	Smudged	or spotted (rarely immaculate)	Immaculate
Dorsal pattern	Dense black markings, tending to a checkered pattern	Dense black markings	Smudgy, very dense	Sparse, tending toward formation of transverse irregular bands	Extremely dense
Ventral pattern	Similar to dorsal, but much lighter	Similar to dorsal but lesser amount of black	Almost as dense as dorsal	Almost immaculate	Similar to dorsal
Tail length at body—length 400 mm.	*	50.0 mm	59.0	67.5	**
Distribution	Guianas, Trinidad, Venezuela	Middle Amazon	Uplands and Pacific coast of Colombia, Panama	Ucayali River valley	Santa Maria, State of Baía, Brasil

* Too variable within the range.
** Too few specimens.

more than a hundred years ago. I have seen the excellent collections assembled by Ernesto Garbe for the Museu Paulista in the same region, including, for instance, the rare *Amphisbaena leucocephala* Peters, a new species allied to *A. steindachneri*, etc., and not a single specimen of *A. fuliginosa*. There are, however, reasons to believe that the species really exists or has existed in the region of Ilheus. There is a close relationship between the fauna of the humid forest of eastern Brasil and the Amazonian fauna, from which the former is separated by a broad belt of savanna with diverse faunal composition. This fact will receive more attention in connection with the mode of evolution of *A. fuliginosa*.

If we accept the locality data of the three Maximilian specimens, as I see no reason for not doing, it is necessary to give them subspecific rank, as the differences from the other samples are numerous and striking.

We have in this way considered five subspecies of *A. fuliginosa*. The validity of these races does not depend solely on the demonstration of statistical differences but, also, on the possibility of identifying isolated specimens in the museum. Nomenclature was never intended to, nor can it, describe the great complexity of evolutionary patterns. In groups, such as *Peromyscus*, intensively worked from an evolutionary viewpoint, a compromise has been reached between the need of acknowledging through the name morphological differences and the unreasonable splitting that results from too strict an adherence to the statistical significance of differences.

The five races here recognized are listed in Table 23 which will serve as differential diagnosis for all. The names under which they appear have been assigned for reasons discussed below.

Specimens of *varia* are easy to identify, on account of the very characteristic color pattern and low number of body annuli.

Among the forms with yellow ground color, *bassleri* and *wiedi* are easy to recognize with the aid of the dorsal pattern and additional characters, such as number of tail annuli in *bassleri*.

The subspecies *amazonica* is readily identifiable by the combination of high body annuli counts and immaculate head. There is some overlap with *bassleri* and *fuliginosa*. The subsidiary characters, however, permit a good separation.

To my way of thinking, the hardest separation is between *bassleri* and *fuliginosa*, dependent on color pattern and number of tail annuli, a character not always present and not too sharply diagnostic. But here again the ancillary characters (chiefly number of pores and segments) afford good elements for separation.

Mode of evolution of *A. fuliginosa*

In taxonomic discussions of evolutionary patterns a prominent place is usually given to the identification and discussion of "centers of dispersal". Several rules and "laws" have been advanced for that purpose.

In the case of South American forms I believe a different attitude to be more fruitful: instead of looking for centers of distribution, to consider only the modifications of the probable Pleistocene ranges of the form or forms involved. In the case of forms that entered South America during the Pliocene, there is of course a secondary center of dispersal to be considered — the Isthmus of Panama. But even in the elucidation of the history of such genera including species outside of South America the concept of centers of dispersal seems to me rather unsatisfactory. Perhaps the most, if not the only, legitimate application of such a concept would be in the case of forms existing in areas submitted to glaciation and temporarily restricted to refuges. This does not seem to be the case with any of the reptiles and amphibians that entered South America through the Isthmus of Panama.

Before beginning a discussion of the origin and meaning of the observed distribution of *A. fuliginosa,* some preliminary considerations must be undertaken.

A. fuliginosa is most certainly a very ancient inhabitant of South America. It is not an "Old Northern" element (Dunn, 1931) but an indigenous one. No evidence is available as to the geological age of the species or even the genus. The North American genus *Rhineura* is present in the Oligocene of the United States, and I should think *Amphisbaena* is at least as old. What seems to me indirect proof of the antiquity of *Amphisbaena* is the existence in Africa of some species closely related to the South American ones.

Another remark concerns the abundance of *A. fuliginosa.* From the data gathered on the occurrence of the species of *Amphisbaena* it seems that the relative frequency of *A. fuliginosa* varies from one part of the range to another. This relative frequency would be maximum in northwestern South America and minimum in the Brasilian territory outside the Amazon valley. Such variations in abundance are in most forms ascribable to accidents of sampling, especially in the case of subterranean forms. *A. fuliginosa,* however, has been collected since pre-Linnean days with about the same relative frequency and I believe the data above reflect the true situation.

Another remark concerns the limitations of this study. I have little or no material from vast and important areas in Venezuela, French Guiana, the whole lower Amazon and most of the Brasilian territory and the Peruvian Andes.

With these remarks in mind, let us analyze the evolutive features of the distribution of *A. fuliginosa.*

Several of the characters investigated have a "checkerboard" type of distribution; such are the number of segments and pores, the number of tail annuli and the tail length.

This type of differentiation can result either from non-adaptive evolution or from adaptation to very specialized conditions. I can imagine two of those characters as being directly adaptive: the tail length and the number of segments.

The tail length might be of adaptive value in relation to predation. The chief predators of the amphisbaenids are the coral snakes of the genus *Micrurus,* that are frequently collected while swallowing or soon after having swallowed amphisbaenids. I suspect this is the adaptive explanation of an optimum point of fracture in the tail; this point of fracture is present not only in *Amphisbaena* but also in *Aulura,* a genus of leposternoid affinities. I can conceive there would be some advantage in the dropping of a longer tail in the mouth of a hungry pursuer.

Also in connection with predation could be found a direct adaptive value of the increase in number of segments to a midbody annulus. If this number of segments corresponds to the girth, it is reasonable to suppose that an animal with more segments, i.e., thicker, would be harder to prey upon. But our data do not permit us to check on the relationship between number of segments and girth and so these considerations are, for the moment, pointless.

Turning now to the consideration of the color pattern and of the number of body annuli, we find a more interesting picture.

These two characters vary almost parallelly. One might assume that they are either determined by pleiotropic genes or linked. The first hypothesis is improbable, for such a complex color pattern is probably determined by a complex genetic mechanism. The hypothesis of linkage may be dismissed by the observation of specimens presenting contrasting values of the two varieties (*A. f. varia* x *A. f. bassleri,* for instance). I believe this parallel variation of unlinked characters speaks strongly in favor of an adaptive factor in their evolution.

The discussion of the evolutive pattern of *A. fuliginosa* centers around three subspecies: *fuliginosa, bassleri* and *amazonica. A. f. varia* is undoubtedly a highland form that reached the Pacific coast. *A. f. wiedi* is probably a disjunct form and as such will be discussed.

Considering now the three above cited species, we may say that, although *A. f. amazonica* has a range situated between those of *bassleri* and *fuliginosa,* its characteristics are not intermediate between those of the named forms. On the contrary, *bassleri* and *fuliginosa* are very closely related forms, differing chiefly in color.

This situation could have arisen in two ways: (a) *amazonica* giving rise to two convergent forms in different parts of the range; (b) *amazonica* being the result of the evolution of a population occupying the central part of a territory, on the fringes of which the primitive stock suffered further but less extreme differentiation.

If we consider now *varia* and *wiedi* we see that they approach more closely the forms with low counts of body annuli (*bassleri* and *fuliginosa*) than *amazonica*. In this manner I believe the second hypothesis listed above is the more probable, and that *fuliginosa* and *wiedi* are closer to the primitive stock than any other race. From the data furnished by the color pattern it would seem that *fuliginosa* is still closer to the parental stock than *wiedi*, but the elements at present available do not warrant investigation of this point.

If the presence of *varia* is easily accounted for, *wiedi* offers a difficult problem. It is one more instance of an eastern Brasilian representative of the Amazonian fauna. Many examples of this peculiar duplication are found in lizards (*Anolis*, *Enyalioides*), snakes (*Leptotyphlops*, *Boa*, *Lachesis*), amphibians (Carvalho, 1946), birds (*Cotingidae*, p. ex.—O. Pinto *in litt.*), mammals (Moojen, 1948) and certainly many other groups.

Moojen's explanation of the fact is sensible and may be summarized here by assuming that central Brasil was covered during the Pleistocene by a tropical forest which vanished before recent times. The causes of this recession are many and need not be discussed here. In our day the humid eastern Brasilian forest, which covers a broad coastal belt from Baia to the northern part of Rio de Janeiro, is separated from the Amazon forest by a stretch of savanna. It is thus perfectly understandable that forms which need a humid environment have become isolated in eastern Brasil from the northern populations. In the case of *A. fuliginosa*, however, if we may feel reasonably sure that a central Brasilian population once existed, there is no need to assume that it is now extinct, for we have three specimens from Ceará, a generally dry state.

The presence of *A. fuliginosa* in northeastern Brasil suggests furthermore an alternative origin for the eastern Brasilian form: migration through the coastal "matas". Discontinuity of suitable environments along this route, however, militates against this mode of origin.

More elements for the solution of this problem would be afforded by a consideration of the relationships of *A. f. wiedi*. The evidence at hand points immediately to a closer relationship to the forms *bassleri* and *fuliginosa*. This may mean either derivation from the primitive stock, which the cited races probably resemble more closely than the remainder, or derivation from one of the two.

A. f. bassleri is so specialized with respect to color that it is unlikely to be a parental form, a role whose requirements are better fulfilled by *fuliginosa*. However, in order to accept *wiedi* as derived from *fuliginosa* by migration, it is necessary that the latter form be found in the lower Amazon. So far we have no evidence either for or against this hypothesis. The material from Ceará and Maranhão, however, seem to indicate that perhaps *amazonica* will be found in Pará and northeastern Maranhão.

This is a problem that will only be settled when adequate material is collected all over the Brasilian range of *A. fuliginosa*.

To summarize the whole argument on the distributional pattern of *A. fuliginosa*, I think it is safe to state that:

The Pleistocene range of the species probably included central Brasil and the Amazon valley up to the Guianas.

Around the Amazon valley three forms evolved: *amazonica*, in the Manaus region, characterized by very high body annuli counts and an immaculate head; *bassleri*, along the Ucayali River valley up to the upper Madre de Dios, presenting a strong differentiation of color pattern and an increase in tail length; *fuliginosa* in the Guianas and Venezuela, showing an increase in number of body segments and preanal pores and preserving many characteristics of the ancestral form. It is possible that differentiation in this region proceeded further and that the present status will be modified.

The primitive amazonic population climbed the Andes, probably before full differentiation of the lowland races; the highland population, extending its range west to the Pacific Ocean and north to the Isthmus of Panama, suffered a striking differentiation of color pattern and a reduction in the number of body annuli.

The mode of origin of the presently disjunct *A. f. wiedi* awaits more adequate data that will permit a satisfactory solution.

The belts of intergradation are very wide, and there seems to be no noticeable restriction of gene flow between the races.

Attribution of names

Amphisbaena fuliginosa is included in the tenth edition of the Systema Naturae. The diagnosis is, of course, very short, but reference is made to two of Linné's previous works.

Linné makes reference in the Systema to two specimens; the pre-Linnean references, however, concern just one of the two. This is described in "Amoenitates Academicae" (1749 **1**: 295) among others belonging to the "Museum Adolpho Fridericianum", more commonly known as "Museum Principis". To this description reference is made in the "Museum Adolphi Friderici Regis" (1754). Of this specimen, preserved in the Royal Museum in Stockholm, I have been supplied with very good photographs and other data, thanks to the kindness of Dr. U. Bergström.

The second specimen is described in another part of the Amoenitates, the "Surinamensia grilliana" (1749a). This book is not cited in the Systema Naturae, but the data on the specimen are. A fine series of photographs of this second cotype, preserved in the Zoological Institute at Uppsala, was made available to me, together with other numerical data, by Dr. Åke Holm.

TABLE 24

A. fuliginosa — Characteristics of the two Linnean cotypes.

Character	*Specimen from*	
	Uppsala	*Stockholm*
Body annuli	205	208
Tail annuli	25	28
Dorsal segments	30	23
Ventral segments	26	26
Preanal pores	10	8
Body and tail length	455+64 mm.	310+45 mm.

In Table 24 are presented the numerical characteristics of these Linnean cotypes.

We shall try to determine the probable origin of these Linnean cotypes.

The Stockholm specimen

The color pattern of the Stockholm specimen, perfectly preserved (fig. 1), belongs to the type found in the Guianas and Manaus.

The number of body annuli (208) would fit well into the Guianan samples (199–213), into the Ucayali race (205–215) and less well into the Manaus race (207–221). (Table 2)

The number of tail annuli (28) would also fit into the Guianan (24–28) and Ucayali (26–30) races. (Table 23)

The number of dorsal segments (23) could belong to any sample, with the possible exception of the Ucayali River one. (Table 9)

The number of ventral annuli (26) points clearly to the Guianas and Manaus. (Table 9)

The number of preanal pores (8) is absolutely nondiagnostic. (Table 10)

The tail length fits best of all the Paramaribo sample, and excludes the Ucayali River race. (Table 12)

On the strength of these data it seems justifiable to believe that the Stockholm cotype of *A. fuliginosa* was collected somewhere in the Guianas.

TABLE 25

A. fuliginosa — Stockholm cotype. Probability of the differences between the observed values for the specimen and the means of the listed samples being due to random variation inside a homogeneous population.

Samples	*Body annuli*	*Tail annuli*	*Dorsal segments*	*Ventral segments*	*Tail length*
Manaus	0.20	0.85	1.00	0.10	0.10
Colombia	0.04	0.57	0.40	0.09	0.60
Panama	0.06	0.70	0.35	0.011	0.24
Iquitos	0.91	0.010	0.014	0.001	0.05
Ucayali	0.50	0.042	0.021	0.011	0.13
Ecuador	0.11	0.74	0.037	0.001	0.65
British Guiana	0.69	0.84	0.16	0.09	0.38
Paramaribo	0.34	0.44	0.44	0.17	0.80
Trinidad	0.57	0.63	0.08	0.07	0.014

TABLE 26

A. fuliginosa — Uppsala cotype. Probability of the differences between the observed values for the specimen and the means of the listed samples being due to random variation inside a homogenous population.

Samples	*Body annuli*	*Tail annuli*	*Dorsal segments*	*Ventral segments*	*Preanal pores*	*Tail length*
Manaus	0.07	0.10	0.001	0.10	0.030	0.13
Colombia	0.10	0.012	0.005	0.09	0.028	0.42
Panama	0.17	0.08	0.001	0.011	0.09	0.020
Iquitos	0.32	0.76	0.001	0.001	0.001	0.030
Ucayali	0.15	0.94	0.001	0.011	0.012	0.036
Ecuador	0.39	0.38	0.001	0.001	0.051	0.09
British Guiana	0.84	0.026	0.001	0.09	0.10	0.026
Paramaribo	0.70	0.10	0.010	0.17	0.15	0.70
Trinidad	0.66	0.043	0.001	0.07	0.014	0.001

The Uppsala specimen

The Uppsala specimen, although apparently normally colored when examined by Linné, is today extremely faded and no elements can be gathered from its color pattern.

The number of body annuli (205) agrees with the Guianan and Ucayalian races, and with no other. (Table 2)

The number of tail annuli (25) may well belong to any sample but the Ucayali one. (Table 7)

The number of dorsal segments is extremely high, higher than any recorded by me. If this is not the product of different methods of counting, it constitutes the highest number for the species. Even so, the only race that closely approaches such a high value is the one from the Guianas (20–28). (Table 8)

The number of ventral segments (26) also agrees with the Guianan samples, and others (all but the Ucayali River race).

The number of preanal pores (10) is characteristic of the Guianan (Dutch Guiana) and eastern Brasilian races. (Table 10)

Finally, the relative tail length is similar to that found in the Dutch Guiana and the Colombia races. (Table 12)

It is a safe conclusion to say that this specimen also is probably originally from the Guianas, more probably Dutch Guiana.

The data above justify me in applying the name *fuliginosa fuliginosa* to the form that inhabits the Guianas and, more specifically, Dutch Guiana, an assignment in conformity with what we know of the origin of the Linnean types.

Laurenti (1768) abandoned the name *fuliginosa* and proposed four species: *vulgaris, varia, magnifica* and *flava.*

The first, *vulgaris,* is described as having "Corpore albo; capite immaculato; dorso maculis fuscis transversis; lateribus, abdomineque rarioribus, vario."

The specimen on which this description was based was "Hospitatur in Museo Illustris. Com. Turriani Viennae". The Illustris. Com. Turrianus was, according to Daudin (1802: 281), the Count of Turn. I have never found any reference to the fate of his collection. As there is nothing to distinguish *vulgaris* from *fuliginosa,* it must be considered a strict synonym.

Amphisbaena flava, based on one of Seba's plates, is also indistinguishable from *fuliginosa* and hence represents another synonym.

Amphisbaena magnifica, also based on Seba, has as a difference a "taenia purpurascente supra oculos". This is no difference and so we have here another synonym of *fuliginosa.*

Amphisbaena varia, which has "corpore albo nigro, spadiceo, gryseoque vario" may be applied to the Colombian-Panamanian form, which agrees with this description as far as color pattern is concerned. Since no specimen is mentioned, nor any reference made to Seba, I present below a re-description and designate a neotype.

Gray (1844: 70) created a new name: *Amphisbaena americana.* This form is said to inhabit "South America, Berbice, Demerara" and for the time being doubtless should be regarded as a synonym of *A. f. fuliginosa*, to be revived in the event of the British Guianan population being recognized as a distinct form.

Amaral (1937) considered *Amphisbaena alba* as a subspecies of *fuliginosa.* As the two subspecies are sympatric everywhere between Baía and Trinidad, and no signs of polymorphism can be detected, there is no need of discussing this fantastic idea.

Since two names are available for the five subspecies here considered, three remain to be named. These I describe below as new.

Description of the subspecies of *A. fuliginosa*

AMPHISBAENA FULIGINOSA FULIGINOSA Linné, 1758

A. fuliginosa Linné, 1758: 229.
A. vulgaris Laurenti, 1768: 66.
A. magnifica Laurenti, 1768: 66.
A. flava Laurenti, 1768: 67.
A. americana Gray, 1844: 70.

Head massive; snout prominent, swollen. Body stocky, reaching a length of at least 420 mm. Tail cylindrical at the base, to the 6th–7th annulus, which is narrower than its neighbors, serving as a point for fractures. The truncated stump does not regenerate but heals perfectly. Distal segment of tail swollen.

Rostral moderate, low; nasals large, in contact with the second upper labial; prefrontals moderate; postfrontals together forming a rough hexagon, wider than long; occipitals variable; ocular irregular and extremely variable; eye usually visible; three upper labials, the first smallest, the second presenting frequent fusions and divisions that resemble pre- and anterior sub-oculars; one subocular, fairly constant, above the third upper labial, which may be split horizontally; two irregular temporal series; symphysial not always separated from the first lower labial, the suture being often incomplete in front; three or four lower labials, first fairly large, second often longitudinally split, the narrower part outside; one pair of chin-shields; post-symphysial elongate, sometimes split longitudinally, in contact or not with the first lower labial; shields following the chin-shields extremely variable.

Body annuli 196–213; tail annuli 24–28; segments to a midbody annulus 20–28/20–28; preanal pores 6–10; tail length at 400 mm body length variable within a very wide range.

Ground color yellow. Head immaculate or spotted; dorsal spots rather crowded, with distinct margins, tending toward a checkered pattern. Abdomen showing much less black than the dorsum.

Range. From Trinidad, where it intergrades with *A. f. varia,* to French Guiana. Intergradation to the south with *A. f. amazonica.*

Note. When identifying a specimen suspected of belonging to this race, use should be made of the various tables in the text, due to the heterogeneity of this form.

Type material. 1 sp. in Stockholm Museum; 1 sp. in Uppsala Univ.

AMPHISBAENA FULIGINOSA VARIA Laurenti, 1768

A. varia Laurenti, 1768: 66.

Scutellation agreeing with that of the typical form.

Body annuli 190–205; tail annuli 23–27; segments to a midbody annulus 20–26/20–26; preanal pores 6–9; tail length at 400 mm body length varying around 59.0 mm.

Ground color a dirty pinkish. Dorsal markings smudgy, very dense, almost obliterating the ground color. Abdomen as densely colored as dorsum.

Range. Panama and Colombia southward to near Villavicencio; southwestward to Ecuador and eastward to Venezuela near Trinidad. Intergradation with *amazonica, fuliginosa* and *bassleri.*

Type material.

Neotype MCZ 22070, ♂, from Barro Colorado Id., Panama, Canal Zone.

Paratypes

♂ ♂ MCZ 18924, 24004, 37874. USNM 38399.
♀ ♀ MCZ 18925, 24003, 37106, 37123. USNM 37859.
Not sexed BM 714.

AMPHISBAENA FULIGINOSA BASSLERI, subspec. nov.

Scutellation agreeing with that of the typical form.

Body annuli 204–215; tail annuli 26–30; segments to a midbody annulus 20–22/18–24; preanal pores 6–8; tail length at 400 mm body length varying around 67.5 mm.

Ground color yellowish. Head immaculate or spotted. Dorsal spots rarer than in any other form, with a tendency toward formation of narrow cross-bands. Abdomen usually nearly immaculate.

Range. Southern Peru and the Ucayali River valley up to the upper Amazon in Loreto. Intergradation with *varia* and *amazonica.*

Type material

Type AMNH 56606, ♂, from Roaboya, Loreto, Peru.

Paratypes

♂ ♂ AMNH 45624, 56590, 56594, 56597, 56599, 56603, 56607, 56608, 56610, 56613. CM 45472.

♀ ♀ AMNH 56310, 56588, 56589, 56592, 56596, 56598, 56601, 56602, 56605, 56609, 56611, 56617, 56618, 56660. CM 45471. MCZ 45784.

Not sexed BM 703, 704, 740, 744.

This form is named after the late Dr. Harvey Bassler, from whose splendid collection in the American Museum of Natural History almost all the material used in this description was obtained.

AMPHISBAENA FULIGINOSA AMAZONICA, subspec. nov.

Scutellation agreeing with that of the typical form.

Body annuli 207–221; tail annuli 24–27; segments to a midbody annulus 22–26/22–26; preanal pores 8–9; tail length at 400 mm body length varying around 50.0 mm.

Ground color yellowish. Head almost always immaculate; dorsal spots resembling the typical form; abdomen scarcely spotted.

Range. The Amazon valley from Manaus up to Leticia; possibly also the lower Amazon and northeastern Brasil. Intergradation with *bassleri*, *varia* and *fuliginosa;* possibly also with *wiedi.*

Type material

Type IB 674, ♀ from Manaus, Amazonas, Brasil.

Paratypes

♂ ♂ AMNH 64917; MCZ 19540, 20663, 20665.

♀ ♀ AMNH 64918, 64919; DZ 1927; IB 673; MCZ 20664.

AMPHISBAENA FULIGINOSA WIEDI, subspec. nov.

Scutellation agreeing with that of the typical form.

Body annuli 197–206; tail annuli 24–28; segments to a midbody annulus 26/24–26; preanal pores 8–10.

Ground color yellowish. Head immaculate or with very little spotting; dorsal spots very dense, almost completely obliterating the ground color; abdomen equally heavily colored.

Range. Known only from the type locality, Santa Maria, Baía, Brasil.

Type material

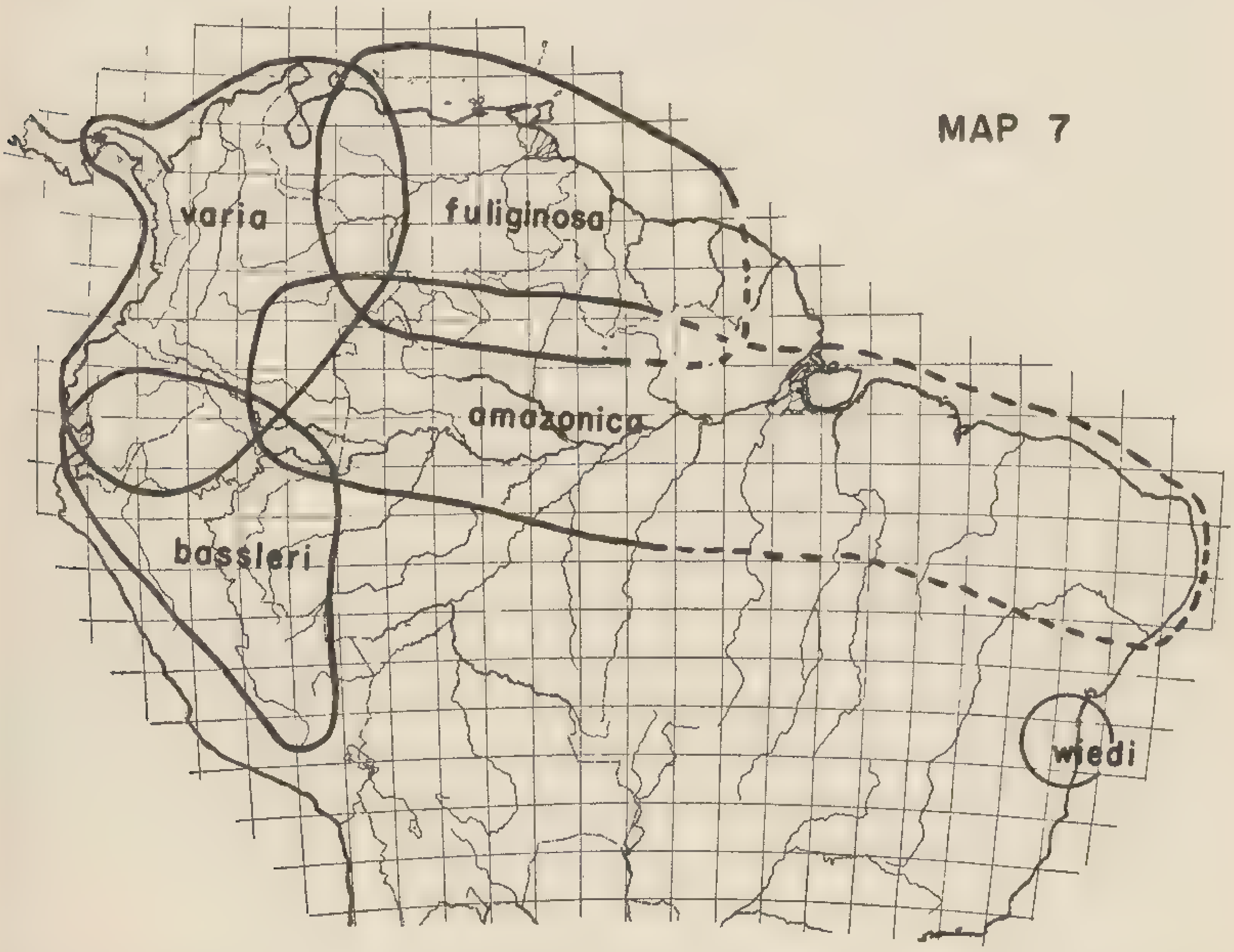
Type AMNH 1091, ♀.

Paratypes ♂ ♂ AMNH 1092, 1093.

SUMMARY

In this paper the distribution and differentiation of *Amphisbaena fuliginosa* are studied with the purpose of furnishing additional materials for the comparative study of patterns and mechanisms of evolution in natural populations.

One hundred and twenty-nine specimens were examined and 7 characters finally selected for statistical analysis: number of body annuli, number of tail annuli, number of segments to a midbody annulus (dorsal and ventral), number of preanal pores, relative tail length and color.



Map 7. *A. fuliginosa.* Tentative distribution of the races recognized in this paper.

The problem was first approached through a study of differentiation and intergradation of each character. For this purpose 9 basic samples were assembled; the criteria for their formation were the number of specimens available and the ecological homogeneity of the localities represented.

The results of this analysis were utilized for a study of the total likenesses and differences between the several samples, employing all the elements available.

From this study the conclusion was reached that five subspecies can be recognized in the territory covered. The recognition of these subspecies is a matter of convenience, since statistical differences between samples were found in all cases. Recognition was given only to those forms to which it is possible to ascribe a single individual or small sample with a reasonable degree of certainty. No arithmetical definition was attempted of this degree of certainty, but it is undoubtedly high in the forms considered. As a result of this policy one subspecies (*A. f. fuliginosa*) is based on somewhat heterogeneous material and it is to be expected that modifications of its status will follow the study of more abundant material.

A pattern of evolution was put forward to explain the observed distribution. This pattern postulates Pleistocene occupancy of central Brasil and the Amazon valley. Spread of the primitive population to northern South America resulted in the differentiation of three races: *bassleri,* in Peru, *amazonica,* around Manaus and *fuliginosa* in the Guianas and Venezuela. Finally, the Amazonic stock climbed the Andes, originating another race, *varia,* sharply differentiated, which spread to the Pacific coast and Panama. A disjunct race in eastern Brasil, *wiedi,* received no definitive explanation.

Special importance was given to the presentation of the evidence at hand, for this is thought the best course for herpetological systematics as an aid to the study of evolution.

Finally, the deficiencies of the material were pointed out, and the most pressing problems in the taxonomy of the species were indicated.

Many of the problems were treated only in a tentative manner, aiming to furnish a starting point to future research. I feel, however, reasonably sure about the systematic status presented, as it is rather conservative and has already withstood a practical test in the identification of the British Museum collection and other material.

ACKNOWLEDGMENTS

This study was made possible by the loans of material belonging to several institutions listed at the beginning of this paper. I am much indebted to their authorities, namely: Mr. C. M. Bogert and Mrs. B. M. Hecht at the American Museum of Natural History; Messrs. A. Loveridge and B. Shreve at the Museum of Comparative Zoölogy; Dr. K. P. Schmidt at the Chicago Natural History Museum; Dr. E. R. Dunn at the Academy of Natural Sciences of Philadelphia; Dr. Doris M. Cochran at the United States National Museum; Mr. J. R. Slevin at the California Academy of Sciences; Dr. G. S. Myers at the Museum

of Zoölogy at Stanford University; Mr. A. Hoge at the Instituto Butantan and Dr. H. W. Parker at the British Museum.

I am also very much indebted to Dr. A. S. Romer and Mr. A. Loveridge for the facilities necessary to accomplish this work and for many helpful suggestions.

During the preparation of this paper I received much help and encouragement from Dr. P. J. Darlington and Mr. C. M. Bogert, both of whom also read the manuscript. Also during the elaboration of this paper I had occasion to discuss repeatedly the problems here treated with Dr. Ernest E. Williams and Mr. Rodolfo Ruibal. None of these friends is, however, to be blamed for the shortcomings of this study.

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PLATE 1

Fig. 1. Linnean cotype of *A. f. fuliginosa* preserved at Stockholm. Kindness of Dr. U. Bergström.

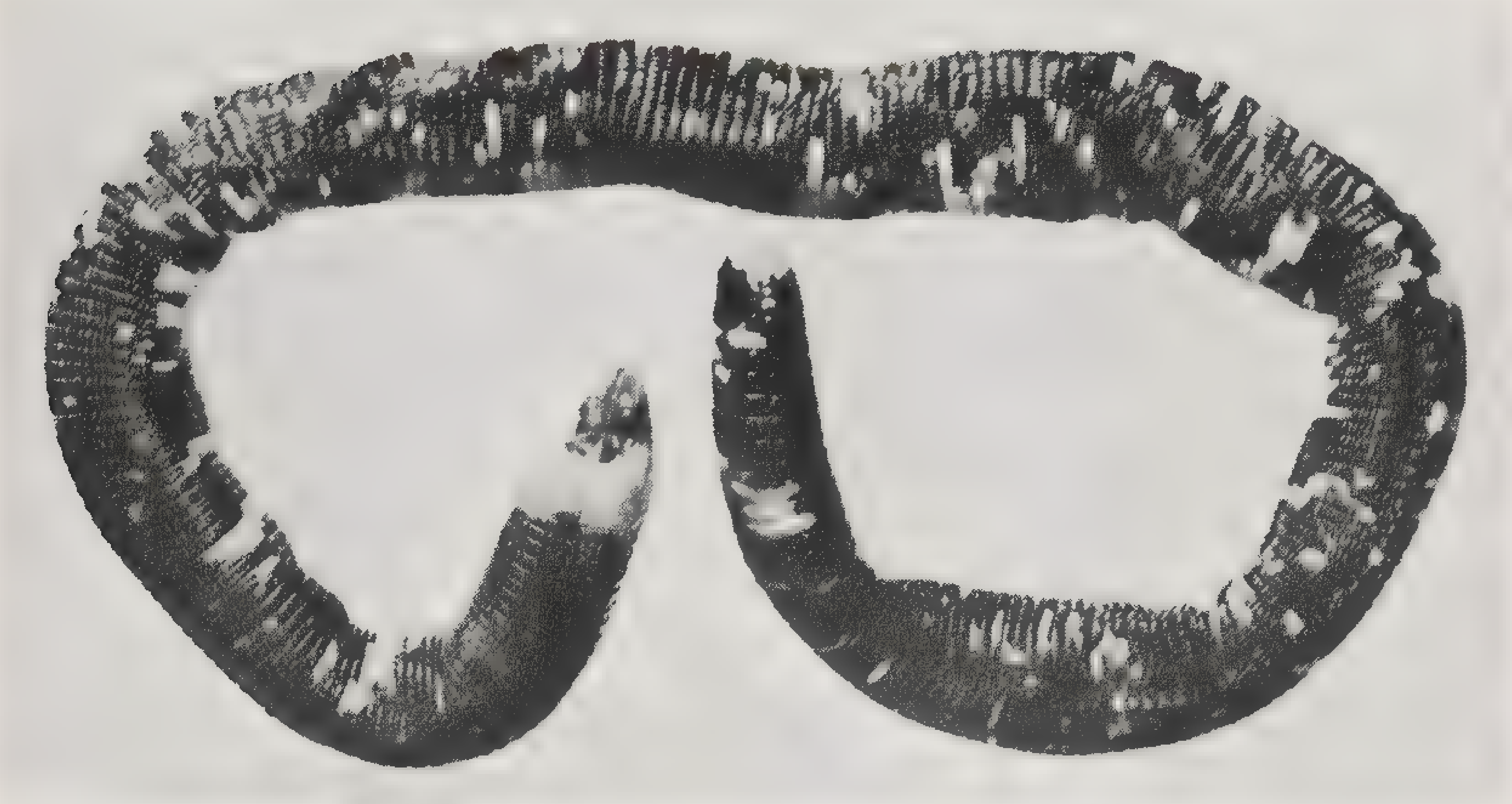


PLATE **2**

Fig. 2. *A. f. fuliginosa.* AMNH 8134. Paramaribo, Dutch Guiana.

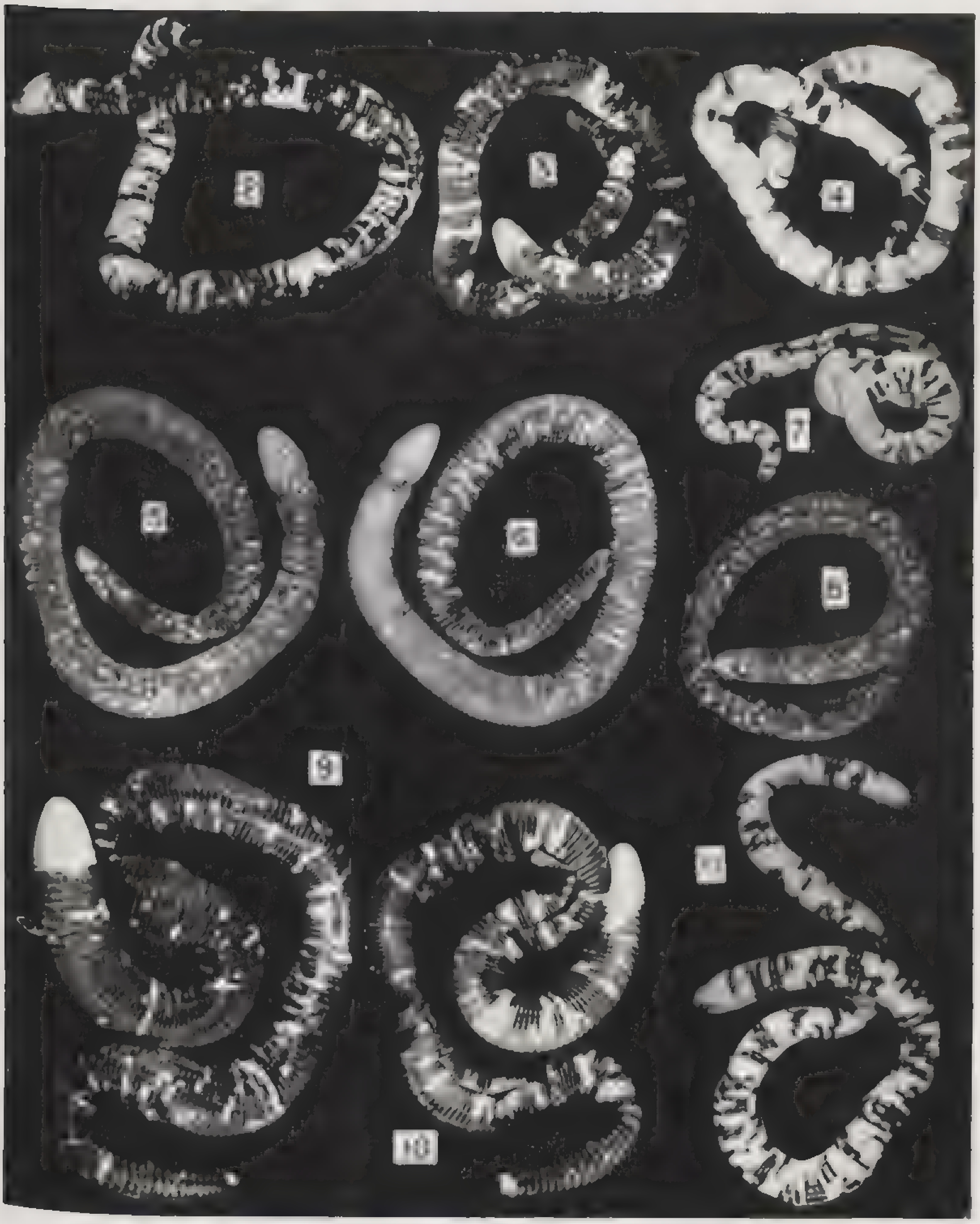
Figs. 3, 4. *A. f. amazonica.* IB 673. Manaus, Amazonas, Brasil. Type.

Figs. 5, 6. *A. f. varia.* MCZ 22070. Barro Colorado Id., Canal Zone, Panama. Neotype.

Figs. 7, 8. Intergrades between *A. f. varia* and *A. f. bassleri.* AMNH 2285 and 23326. Riobamba, Ecuador.

Figs. 9, 10. *A. f. wiedi.* AMNH 1091. Santa Maria, Baía, Brasil. Type.

Fig. 11. *A. f. bassleri.* AMNH 56606. Roaboya, Loreto, Peru. Type.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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. 106, No. 2

BREEDING AND OTHER NOTES FROM NYASALAND AND THE LUNDAZI DISTRICT OF NORTHERN RHODESIA

By C. W. Benson

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
June, 1951

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No. 2. — *Breeding and Other Notes from Nyasaland and the Lundazi District of Northern Rhodesia*

By C. W. Benson

CONTENTS

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Introduction (abbreviations; localities; acknowledgements; literature).. 69
Breeding and other Notes in Systematic Order.................... 72
Summary... 114

INTRODUCTION

This paper supplements earlier published contributions on the ornithology of Nyasaland, while also recorded are birds from the Lundazi district, Northern Rhodesia, adjacent to the Mzimba district of Nyasaland. Thanks to the cooperation of Mr. E. L. Button, District Commissioner at Lundazi, my African collector, Jali Makawa, made two visits to the district during 1948. Some of the results have already been published in Bull. Brit. Orn. Cl., **69**, 1949: 58–60.

Particular attention is paid to the describing of nests and eggs of species or races about which little or nothing has been published previously. In other better known cases no such detail is given, but data are briefly recorded which allow a more precise assessment of breeding seasons and clutch-sizes in this part of Africa. The services of my collector were loaned to Mr. A. Loveridge for his visit to the Nyika Plateau in October-November 1948, during his expedition to Nyasaland and Portuguese East Africa in 1948–9, on behalf of the Museum of Comparative Zoölogy.[1] It was agreed that my collector should pay special attention to the finding of nests and eggs, and that all those taken by Loveridge on the Nyika should be recorded by me in this paper.

In most cases Loveridge was present when one or other, or both, of the parents were collected, so that there could be no doubt as to identification. In the few instances when he was not present I am nevertheless satisfied that no mistake has been made. Details as to state of incubation, environment, *etc.*, are from Loveridge's original notes. In the case of breeding records by myself, from elsewhere than the Nyika, identification was established by myself beyond doubt, and when considered necessary, by collection of a parent.

[1] Assisted by a grant from the Penrose Fund of the American Philosophical Society.

All birds and/or eggs collected are shown in a special preliminary paragraph under the relevant heading. Those given to the Museum of Comparative Zoölogy are suffixed (MCZ), similarly birds to the British Museum, or eggs to Captain C. R. S. Pitman, D.S.O., M.C., Game Warden to the Uganda Government, (BM) or (P) respectively. The descriptions of eggs given to Pitman are by him, for which I am duly grateful. All birds and eggs given to the Museum of Comparative Zoölogy are recorded, and in the case of eggs of passerine species, most of the nests have also been preserved and sent to that institution.

The following abbreviations are used in regard to eggs:

C/	with a number refers to a clutch of so many eggs, as indicated by the number.
N	refers to eggs hatched, young still in nest.
f	fresh.
s.i.	slightly incubated.
m.i.	moderately incubated.
h.i.	heavily incubated.

In regard to localities cited, where "Nyika" occurs in preliminary paragraphs of specimens collected it refers to Loveridge's collecting locality near the top of the eastern escarpment of the Nyika Plateau, at 7,000–7,500 feet above sea-level, and above Nchenachena. See Ibis, 1940: plate 1. The exact position of the place called Nchenachena, on the Nchenachena stream, at the foot of the escarpment, at about 4,500 feet altitude, is 10°46′S., 34°00′E. Nchenachena mountain, whose summit is 8,340 feet, is on the plateau, near the top of the escarpment.

"Vipya" refers to a locality about 15 miles north-east of Mzimba, on the Vipya Plateau at 6,000 feet. All other localities perhaps not otherwise easily traceable will be found on the map in Belcher's "Birds of Nyasaland" (1930), except the following:

NYASALAND

Dedza District: Mphunzi.
Mzimba District: Edingeni; Emfeni; Mkocha; Njakwa; Vwaza Marsh.
Ncheu District: Mitongwe.
} see map in Ibis, 1940, plate 1.

Lake Kasuni (see same map as slightly corrected in Ibis, 1942: 199, at foot). When I visited "lake" Nderendere, see same reference, I found it dried up, and saw practically none of the many species of waterfowl which I had seen at the same season in 1940. But all were seen on the edge of Lake Kasuni.

The position of each of the following localities, relative to one on Belcher's map, or Ibis, 1940: plate 1, with approximate altitude in feet above sea-level, is as follows:

Katete, 40 miles south of Mzimba, 4,500 ft.
Katumbi, adjacent to eastern extremity of Vwaza Marsh, 4,000 ft.
Matipa, 10 miles east-north-east of Fort Hill, 6,000 ft.
Mkhoma, 20 miles east of Lilongwe, 4,000 ft.
Mwanda Hill on the Nyasaland-Northern Rhodesia boundary, 35 miles north-west of Njakwa.
Mwanjati, 10 miles north-east of Katete (see above), 5,500 ft.
Vintukhutu, 2 miles west of Deep Bay, 1,800 ft.

Incidentally Nyankhowa has been mis-spelt "Nyakhowa" both on Belcher's map and on plate 1 of the Ibis, 1940.

LUNDAZI DISTRICT, NORTHERN RHODESIA

The position, and approximate altitude in feet above sea-level, of each collecting locality is as follows:

Jombo, 10°27′S., 33°17′E., is at the southern end of the Mukutu mountains, at various altitudes as indicated.
Katambara, 11°00′S., 32°24′E., 4,800 ft.
Kolala, 11°04′S., 32°22′E., 4,800 ft.
Lundazi, 12°15′S., 33°12′E., 3,500 ft.
Mpanyankunda, 11°16′S., 32°45′E., 2,200 ft.
Muliro, 10°40′S., 32°57′E., 2,500 ft.
Muzyatama, 11°01′S., 32°27′E., 4,800 ft.
Sitwe, 10°52′S., 33°12′E., 2,500 ft.
Tembwe, 11°21′S., 32°55′E., 1,800 ft.

Besides the coöperation which I have had from Mr. Loveridge, I am grateful to Mr. J. L. Peters for arranging for publication of this paper. I am also indebted to Sir Charles Belcher and the Rev. A. H. Paget-Wilkes for answering various questions which I have put to them, arising from information published by them. The latter has most generously allowed me to make use of his original notes and register of eggs. Several references are made to specimens in the private collections of Mr. E. L. Button and Mr. D. W. K. Macpherson, which they have very kindly allowed me to examine. The following have also given me information which I do not hesitate to quote, as being reliable: Dr. D. A. Baird, Mr. A. C. Dent, Drs. H. G. Fitzmaurice, W. A. Glynn, Messrs. W. S. Gray, J. R. Lennon, W. D. Lewis, Miss

R. H. Lowe, Messrs. B. L. Mitchell, P. K. O'Riordan, Rev. J. H. Rens, Mr. G. V. Thorneycroft, Dr. D. P. Turner, Messrs. A. S. Watson, R. G. Willan, R. C. Wood, and the Rev. W. P. Young.

All specimens of birds have been identified in the British Museum, and I thank Mr. J. D. Macdonald and his staff for help in various ways, and Captain C. H. B. Grant for checking my identifications. Full references to literature are given, except in the case of the following where merely the author's name is cited:

Belcher, C. F., 1930. "The Birds of Nyasaland."
Friedmann, H., 1948. "The Parasitic Cuckoos of Africa." Mon. 1, Wash. Acad. Sci.
Sclater, W. L., 1924–30. "Systema Avium Ethiopicarum."
Witherby, H. F., *et al.*, 1938–41. "The Handbook of British Birds."

The nomenclature followed is that of Peters' "Check-list of Birds of the World," as so far published (vols. 1–6, 1931–48). In the case of species as yet not dealt with by Peters, I have followed Sclater. Departures from nomenclature in one or other of these works which are followed are supported by references.

Breeding and Other Notes in Systematic Order

PELECANUS ONOCROTALUS Linné

Six pelicans seen at Lake Kasuni, 28 November, had yellow, not pink, pouches, and so were presumably referable to this species and not *P. rufescens.*

PHALACROCORAX CARBO near LUCIDUS (Lichtenstein)

Mitchell found eggs already laid on Bwadzulu Island, 4 April, and Lowe "nesting in full swing there" in June. A stray bird was seen at the Imperial Tobacco Company dam, Limbe, 27 December.

ARDEA MELANOCEPHALA Vigors and Children

1 Sex ?, Karonga, May (MCZ)

NYCTICORAX NYCTICORAX NYCTICORAX (Linné)

♂, Mzimba, 25 April (MCZ)

CICONIA NIGRA (Linné)

Recorded as breeding in Nyasaland (Bull. Brit. Orn. Cl., **68**, 1947–8: 33) Belcher gives one instance of a palaearctic migrant, a bird ringed in Germany, being killed at Lake Chilwa. From records in the Government Secretariat at Zomba I find that it was ringed by the Rossitten station (No. B16052), and killed in October, 1927, and another, from the description undoubtedly this species, ringed in Hungary (TH Kozponi, DAP Hungaria 7509), was killed near Fort Hill in March, 1925.

DISSOURA EPISCOPUS MICROSCELIS (Gray)

One seen by Rens at Mkhoma, 20 August, and another by myself at Fort Johnston, December.

ANASTOMUS LAMELLIGERUS LAMELLIGERUS Temminck

About fifty seen on edge of Lake Kasuni, 28 November, and twelve by River Bua at 3,000 feet, 22 December.

HAGEDASHIA HAGEDASH ERLANGERI Neumann

Two seen on Vwaza Marsh, 31 October, where evidently the species is a regular visitor as its call is well known to the local natives.

PLEGADIS FALCINELLUS FALCINELLUS (Linné)

Belcher suggests this species is breeding locally; see also the record given in the Ibis (1940: 281). The following too were probably not palaearctic-bred birds: nine, Emfeni, 11 June; about one hundred, Lake Chilwa, 30 July.

PLATALEA ALBA Scopoli

Three seen on Lake Kasuni, 5 December; one on Lake Chilwa, 30 July; two at Fort Johnston, 9 November; sixteen at Kotakota, 2 December; four at Chiromo, 6 December.

PHOENICOPTERUS RUBER ROSEUS Pallas[1] and PHOENICONAIAS MINOR (Geoffroy)

Belcher records *P. minor* on the authority of Kirk (Ibis, 1864: 335), who writes: "*Phoenicopterus parvus*. Zambesi Delta, Shiré Valley,

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[1] Not *P. r. antiquorum*, see Bull. Brit. Orn. Cl., **54**, 1933: 16–17.

Lake Nyassa, Mozambique. A constant dweller throughout the year in the Zambesi Delta. Found in other parts during the wet season only. It is commonly in large flocks. Considered excellent food, but difficult to obtain." It is not clear that Kirk distinguished between *P. minor* and *P. ruber*, or that he preserved a specimen. Nor indeed have I been able to trace an example of either species collected by Kirk in Nyasaland or Portuguese East Africa, in the British Museum, nor even a record of one in their register. It appears that all his collections went to the British Museum, see "History of the Collections" (**2**,1906: 407; and Ibis, 1908, Suppl.: 195). The record by Sperling (Ibis, 1868: 292) of *P. erythraeus* in large flocks on the Mozambique flats in November, presumably refers to *P. ruber*. Alexander (Ibis, 1900: 442) records flocks of *P. roseus* (= *P. ruber*) on the Zambesi delta in July. See also Ostrich (1936: 34, and 1945: 38) for records of *P. ruber* from Beira. Four specimens of *P. ruber* have been obtained in Nyasaland (see Belcher; also Ibis, 1940: 281; 1948: 389; Ann. Transvaal Mus., **21** (2), 1949: 177), while in the British Museum there are two collected by W. A. Churchill at Mozambique; undated. *P. ruber* (presumably) is frequent at Fort Johnston in September and October, and occasionally between November and April. In September 1942 flocks of fifty or more birds migrating southwards were especially noticeable. Their calls during flight were heard by night as well as by day. The call is very goose-like, as stated by Witherby (**3**, 1939: 164). On present evidence *P. minor* cannot be accepted as ever occurring in Nyasaland, nor to my knowledge is there any certain record of its occurrence in Portuguese East Africa.

DENDROCYGNA BICOLOR BICOLOR (Vieillot)

Lewis saw a pair accompanied by seven sandy-coloured ducklings, about one week old, on Lake Chilwa, 17 September.

SARKIDIORNIS MELANOTOS (Pennant)

Thorneycroft reports seeing many adults quite unable to fly, their primaries and secondaries only starting to emerge from the sheaths; Lake Chilwa, October, 1940.

ANAS SPARSA SPARSA Eyton

2 Sex ?, Mzimba, 28 September (MCZ)

See Bull. Brit. Orn. Cl., **53**, 1933: 243–244.

NETTAPUS AURITUS (Boddaert)

♀, Tembwe, 17 April (MCZ)

Turner saw an adult, accompanied by young only three-quarters of adult size which were still weak on the wing; Kotakota, April.

AYTHYA ERYTHROPHTHALMA (Wied)

C/8 s.i., Edingeni, 20 June (P)

Nest in a vlei, through which a 12-foot wide perennial stream flowed sluggishly, on dry flat ground two feet above water-level, three feet from water's edge. Eggs hidden by down, except for two central eggs only partially concealed. They are buffy-white, smooth-surfaced, slightly glossed; average size 58.9 x 42.5 mm.

Aythya has priority over *Nyroca*, see Witherby (**3**, 1939: 286).

MILVUS MIGRANS PARASITUS (Daudin)

♀, Karonga, 15 March (MCZ)

Two nestlings starting to moult from white down were brought to me at Mzimba, 24 October; other breeding records are: C/1, Emfeni, 22 October; C/2 h.i., 15 miles north of Blantyre at 2,500 feet, 23 September.

Records given in the Ibis (1940: 285) indicate this bird to be largely a migrant, and further observations confirm this. Few are seen anywhere in Nyasaland between February and late July. Gray counted a flock of twenty-one migrating southwards over Mzimba, 31 July.

ACCIPITER MELANOLEUCUS MELANOLEUCUS Smith

A bird was seen sitting tightly on its nest in an *Erythrina* tree at the edge of riparian scrub through *Brachystegia* woodlands, near Mzimba, 26 September. An African, sent up to examine it, reported two eggs, which were not taken.

ACCIPITER TACHIRO TACHIRO (Daudin)

♂, Muzyatama, 10 May (MCZ)

Regarding reference see Bull. Brit. Orn. Cl., **54**, 1934: 131.

ACCIPITER BADIUS POLYZONOIDES Smith

♀, Mzimba, 19 November (MCZ)

At nest with three young starting to moult from white down.

MELIËRAX METABATES MECHOWI Cabanis

♂, Katambara, 7 May (MCZ)

KAUPIFALCO MONOGRAMMICUS (Temminck)

Two young starting to moult from white down were brought to me from a single nest at Mzimba, 15 December. Also on the same day a single bird from another nest, similar to that described in the Ann. Transvaal Mus., **21** (2), 1949: 161. For reasons for employing binomials, see Bull. Brit. Orn. Cl., **54**, 1934: 130.

STEPHANOAËTUS CORONATUS (Linné)

1 Sex ? (wing only), Ekwendeni, June (MCZ)
1 Sex ? (foot only), Ekwendeni, December (BM)

I have also the following sight-records of single birds: Fort Johnston, 14 February; Chikwawa, 6 August; Matope, 14 May; Zomba, 19 March.

POLEMAËTUS BELLICOSUS (Daudin)

A nest containing one young bird was seen in *Brachystegia* woodland near Mzimba, 26 September. The nest was in a tree which I did not climb, on a very steep slope. The nestling, when seen from a distance of about twenty yards, appeared to have recently hatched. On 6 November it was still in the nest but almost fledged. It was examined, and the following is a brief description: bill dark slate, tongue pink with black tip; iris dark brown; feathers of upperside sepia tipped white, though mantle darker, with hardly any white tipping; feathers on side of neck white tipped sepia; flanks grey; under surface of wings white, with primaries and secondaries sepia; underside pure white, feathered to base of tarsi; feet pale greenish-yellow; claws slate.

A nest has been reported by Watson in *Brachystegia* woodland near Lilongwe. The single egg hatched in late July. The young bird was kept by Watson for falconry, and when examined by me five months later was generally similar to that described above, though practically fullgrown. The breeding records given in the Ibis (1928: 717) are open to doubt. There may have been confusion with *Circaëtus pectoralis*. Reference is made to a habit of hovering, characteristic of that species, and not of *Polemaëtus,* also to the young bird being fed with a snake, which is also more likely to refer to *C. pectoralis*.

HIERAAËTUS FASCIATUS SPILOGASTER (Bonaparte)

Two nestlings, starting to moult from downy plumage, and taken from the same nest, were brought to me at Mzimba, 12 August. They were given to a friend to rear for falconry, and when examined by me again four months later were definitely determined as this species; not *H. dubius*.

AQUILA RAPAX RAPTOR Brehm

♂, Lake Kasuni, 28 November (BM)

For the only other definite Nyasaland record of this species (*A. r. rapax*), see Ibis (1944: 449). The breeding record for the Kirk Range (Ibis, 1928: 715) requires confirmation; Paget-Wilkes *in litt.* states that no specimen was obtained.

AQUILA WAHLBERGI Sundevall

♂, Hora, 25 January (MCZ)
♀ with C/1 f., Mzimba, 7 October (MCZ)

TORGOS TRACHELIOTUS TRACHELIOTUS (Forster)

This species is listed by Belcher on the strength of a statement by Stark and Sclater (Fauna of South Africa. Birds, **3**: 390) that it had been "noticed on one occasion in Nyasaland." I am unable to find any further basis for this record. It is not mentioned by Reichenow (Die Vögel Afrikas, **1**, 1899: 512) nor does Sclater in the Systema include Nyasaland within the distribution of the species. There has been no subsequent record of *Torgos tracheliotus* in Nyasaland, and in view of its preference for open, arid regions, uncharacteristic of Nyasaland, and the extent to which the territory has been worked ornithologically, I think it most unlikely that it occurs in the Protectorate.

NEOPHRON PERCNOPTERUS PERCNOPTERUS (Linné)

Included by Belcher on the strength of a record by Kirk (Ibis, 1864: 307) "seen in the mountains to the south of Nyassa; it was not killed

. . ." There is no subsequent Nyasaland record, and there was probably confusion with *Gypohierax angolensis,* which Kirk does not mention, and which does occur in the Shire Highlands (cf. Belcher) and has been seen by me between Limbe and Cholo, where there are *Raphia* palms. I find no evidence for the occurrence in Nyasaland of *Neophron percnopterus,* which, like *Torgos tracheliotus,* seems to prefer open, arid regions.

It is also worth mentioning Alexander's record from Portuguese East Africa. He writes (Ibis, 1900: 438): "Sept. 1. A large flock, quite 100 in number, suddenly appeared at a great altitude this morning — white specks in the sky, as they circled in the sunlight." From the introduction to Alexander's paper it appears that on September 1 he was between Mesanangue and Chicowa, on the Zambesi. It seems more likely that these birds were ibises, perhaps *Ibis ibis,* or storks. The two records by Haagner (Ostrich, 1945: 40) from Beira, the neighborhood of which is exceptionally humid, are also open to doubt.

TERATHOPIUS ECAUDATUS (Daudin)

Turner noticed a nest being built near Karonga in January. On 9 July it contained a single young bird almost ready to fly. Belcher gives breeding as from June onwards, but the foregoing record does not tally with this, nor do the following records from near Dzunje, taken from Paget-Wilkes' egg-register: two C/1 f., 5 March; three C/1, April; one C/1 h.i., 25 May; one C/1, 22 June. C/1 f. is recorded from Mzimba, 29 March (Ostrich, 1945: 50). Belcher (*in litt.*) also gives two C/1 taken by Gray at Mzimba, 1 and 11 April.

CIRCAËTUS CINEREUS Vieillot

I have examined a male in Macpherson's collection taken by him near Domira Bay, 5 December. The stomach contained four snakes. I have a number of sight-records of dark brown eagles, with pale iris and bare tarsus, from Chiromo north to Fort Johnston at 200–1,600 feet, and have also noticed such birds at Karonga and Fort Hill.

CIRCAËTUS FASCIOLATUS Gurney

Recorded by Belcher from the Mwanza, on the strength of a specimen collected by Sharpe as recorded in the Ibis (1898: 556). In the introduction to that paper it is stated that Sharpe had transmitted 329 specimens to P. L. Sclater. There is no Nyasaland specimen of *C.*

fasciolatus in the British Museum, but there is one of *C. cinerascens*, originally identified as *C. fasciolatus*, register number 98.5.1.163, bearing no original collector's label, but one on which is printed "P. L. Sclater Mus." The only further particulars are that it was collected by Sharpe in Nyasaland in 1897. It seems virtually certain that this is the specimen recorded as *C. fasciolatus*, and which, in the absence of other records, cannot be regarded as occurring in Nyasaland.

PANDION HALIAETUS HALIAETUS (Linné)

One was seen on the River Songwe, 24 August, and another by Willan at the Imperial Tobacco Company dam, Limbe, 30 November. No further evidence has been obtained in regard to breeding on Likoma Island (Ibis, 1942: 205), but Wood saw young ones being fed by their parents, in a nest in the upper branches of a tall tree, by the Ruo River near Chiromo; date unrecorded.

FALCO TINNUNCULUS RUPICOLUS Daudin

During several dry seasons, *i.e.* May–October, Dent noticed on his estate at Mitongwe a pair continually associated with one of the brick tobacco barns, in which they were presumably nesting. Unfortunately he cannot recollect any more precise dates. I myself saw a bird perched on such a barn, near Zomba in May.

FRANCOLINUS SHELLEYI

♂, *F. s. whytei* Neumann, Katambara, 7 May (MCZ)

Three specimens of *F. s. shelleyi* Ogilvie-Grant in Button's collection, taken by him at Lundazi, show no trace of intergradation with *F. s. whytei*, whereas specimens in the British Museum from near Mzimba (Ibis, 1937: 405; 1940: 293) are equally clearly *F. s. whytei*. Yet Mzimba and Lundazi are only about 40 miles apart in a straight line.

A female of *F. s. shelleyi* collected by Macpherson, Bandi River, Furancungo district, Portuguese East Africa, 12 January, is labelled "on nest with six eggs."

FRANCOLINUS HILDEBRANDTI

♂♂, Mwanjati, 18 June; 27 September (MCZ)
♀, Kotakota, 31 December (BM)

The Kotakota specimen is clearly *F. h. johnstoni*, but it is impossible to say whether the Mwanjati specimens are *F. h. hildebrandti* Cabanis or *F. h. johnstoni* Shelley, since the two races can only be distinguished by the females (Ibis, 1935: 670).

Breeding records of this species additional to those given in the Ibis (1940: 294; 1944: 450; Ostrich, 1948: 3) are: C/6, Monkey Bay, 8 May; female containing enlarged and yolking eggs, Midima, 3 June; Rens saw eggs at Mphunzi in early November.

FRANCOLINUS SQUAMATUS DONI Benson

Francolinus squamatus doni Benson, Bull. Brit. Orn. Cl., **59**, 1938: 42.

Feathers from a francolin wounded but not secured, in dense evergreen scrub on Mwanjati hill, 21 June, are identical with those of *F. s. doni.*

PTERNISTIS AFER

Belcher gives the breeding season as from March to April. Paget-Wilkes (Ibis, 1928: 726) states that fresh eggs can be found from April to November. According to his egg-register, however, he only took clutches, all from near Dzunje, as follows: C/5, 27 April; C/4, 20 May; two C/6, June; C/5, 29 July; C/1, 20 August. Records given in the Ibis (1934: 337; 1940: 296; 1942: 206) suggest that egg-laying takes place between late December and July.

Further records (regarding *P. cranchii* as conspecific with *P. afer*) are: C/2, Fort Johnston, 9 June; half-grown young, Chikwawa, 13 April; chicks about a week old, Mzimba, 31 March; C/5, Karonga, 26 June; female, eggs in ovary much enlarged, Fort Hill, 21 May. The gonads were small in all six males and four females, all apparently adult, collected at Nchenachena, 4,500 feet, in early September. It would thus appear that eggs are laid from late December to August, laying being probably at its height in February and March.

PTERNISTIS SWAINSONII LUNDAZI White

Pternistis swainsonii lundazi White, Bull. Brit. Orn. Cl., **67**, 1947: 72.
♂♂, Tembwe, 16 and 19 April (MCZ)

Gonads enlarged. Taken in *mopane* woodland, where the grass was short; in contrast to *P. afer,* which prefers long, rank grass. Such an environment is found near the River Hewe, whence Belcher gives the only Nyasaland record. But White (Ibis, 1943: 259) finds no peculiarity in the habitat of *P. swainsonii.*

COTURNIX AFRICANA AFRICANA Temminck and Schlegel

C/6 s.i., Vipya, 3 December (P)

Eggs pale yellowish-clay, fairly glossy, blotched (some coalescing), spotted and freckled brownish, generally but not profusely; size: 30.0 x 22.3; 29.9 x 22.1; 30.2 x 22.3; 30.3 x 22.2; 29.8 x 22.3; 29.7 x 22.3 mm.

In the Ibis (1940: 297) the possibility of seasonal movement is suggested, but further experience makes me regard it as mainly resident on short-grassed downlands at 5,000 feet and over. On the Vipya it may be seen in twos and threes in every month of the year.

COTURNIX DELEGORGUEI DELEGORGUEI Delegorgue

Glenbreck, the breeding locality mentioned by Belcher, is, so he kindly informs me *in litt.*, near Ntondwe, at an altitude of 3,000 feet. It is most unlikely that *C. coturnix* would breed so low, *vide antea.* Turner shot a female containing a fully developed egg, at Kotakota in October, 1933, and there he saw enormous numbers moving northward in the following March and April. Dent saw thousands at Mitongwe for about three weeks in December, 1931.

CRECOPSIS EGREGIA (Peters)

Macpherson shot a male off two eggs about to hatch in a nest at Dzunje, 27 March. Incubation was completed under a domestic hen. When hatched, the young were completely covered in black down (see also Ibis, 1948: 590), and able to run at once. Rens collected a male and a female at a nest with eggs, Mphunzi, 21 March. The eggs recorded in the Ibis (1944: 450) were fresh, and the females collected were ready to lay.

AENIGMATOLIMNAS MARGINALIS (Hartlaub)

♂, Zomba, 8 March (MCZ)

Found by Baird at Zomba hospital, several miles away from the nearest swamps suited to its permanent occurrence, on a night of heavy rain and mist. Gonads enlarged. Bill bluish grey at tip, green at base. Irides crimson, narrow yellow-orange rim of bare skin around eyes. Legs and feet green.

PORPHYRULA ALLENI (Thomson)

♂, Mpanyankunda, 26 April (MCZ)

Feathers were picked up at Hynde's Dam, Limbe, 29 December, where it does not occur regularly, and has not previously been recorded (Ostrich, 1946: 273–279). C/3 f. taken near Chikwawa, 18 February.

LISSOTIS MELANOGASTER MELANOGASTER (Rüppell)

♀, near Mzimba, 5,000 feet, 4 July (MCZ)
C/1 h.i., Loudon, 25 November (MCZ)
C/2 s.i., near Mzimba, 5,000 feet, 3 December (MCZ)

These egg dates considered with those given by Belcher and myself (Ibis, 1937: 554; Ann. Transvaal Mus., **21** (2), 1949: 177) suggest that laying takes place throughout the rainy season.

ROSTRATULA BENGHALENSIS BENGHALENSIS (Linné)

♂, ♀♀, Edingeni, 26 May (MCZ)
♂♂, ♀♀♀, Mpanyankunda, 26–27 April (MCZ)

All with gonads showing breeding activity, one of the Mpanyankunda females held an almost fully developed egg.

HEMIPARRA CRASSIROSTRIS

(Intermediate between *H. c. crassirostris* (Hartlaub) and *H. c. leucoptera* (Reichenow))

♂, Lake Kasuni, 28 November (MCZ)

Belcher (*in litt.*) states that the eggs recorded by him from Lake Chilwa, August, are definitely of this species.

STEPHANIBYX CORONATUS CORONATUS (Boddaert)

C/3 s.i., Lilongwe aerodrome, 16 August (P)

A pair were also noticed in this locality on 11 September. Apparently rare and sporadic in Nyasaland. For the only other definite records, see Ibis (1898: 556; 1899: 167; 1940: 392)

EUPODA ASIATICA (Pallas)

At least forty, none of which showed any trace of breeding plumage, were seen on Lilongwe aerodrome, 30 August.

NUMENIUS PHAEOPUS PHAEOPUS (Linné)

Turner reports shooting one at Karonga in August, and I saw one at Kotakota, 2 October.

TRINGA GLAREOLA Linné

♂, Mzimba, 9 December (MCZ)

CAPELLA MEDIA (Latham)

♂, Mzimba, 7 December (MCZ)

BURHINUS VERMICULATUS VERMICULATUS (Cabanis)

♂, Mpanyankunda, 29 April (MCZ)

CURSORIUS TEMMINCKII TEMMINCKII Swainson

A pair of adults with two young only about one-quarter grown were seen at Lilongwe aerodrome, 11 September. One of the adults, the male presumably, was seen making a vertical-cum-horizontal, circular, movement of the body, the feathers of the chest being puffed out, and the tibia alternately exposed and hidden. This caused the female to approach from a distance of ten yards to within a yard of him, closely followed by the young, which had been lying "doggo," invisible. The female then crouched and the young settled underneath her, whereupon the male moved off unconcernedly, apparently in search of food.

Pairs of young, similar in size to those referred to above, were seen with their parents at Lilongwe, 30 August, and on the Vipya, 14 November. Two others about three-quarters the size of their parents were seen at Ncheu on 15 September.

RHINOPTILUS CINCTUS SEEBOHMI Sharpe

♀, Tembwe, 16 April (MCZ)

The Nyasaland record by Paget Wilkes (Ibis, 1928: 729), cannot be accepted. He states (*in litt.*) that he did not obtain a specimen, and agrees that there was confusion with *R. chalcopterus*, which occurs commonly throughout Nyasaland. But it is just possible that *R. c. cinctus* occurs in the arid *mopane* woodlands near the Vwaza Marsh.

GLAREOLA NORDMANNI Fischer

Kirk (Ibis, 1864: 332) records this species from Lake Nyasa and the Zambesi in October. He does not mention *G. pratincola fülleborni,* which is common. There is no specimen of *G. nordmanni* collected by Kirk in Nyasaland or Portuguese East Africa in the British Museum, though there is one of *G. p. fülleborni* labelled "L. Nyasa (R. Loangwa)," registered number 63.12.30.25. Probably the Dwangwa River is really referred to, not the Loangwa River, which is in Northern Rhodesia. It seems clear that Kirk mistook this species for *G. p. fülleborni. Vide antea,* under *Phoenicopterus, re* disposal of Kirk's collections. There is no other Nyasaland record of *G. nordmanni,* which Slater states is unrecorded from Eastern Africa, though on 18 October, 1939, I did see near Mlangeni, on short grassland over which a fire had recently passed, a single, tired bird which I believe was of this species.

RYNCHOPS FLAVIROSTRIS Vieillot

One seen at Vwaza Marsh, 31 October; three at Lake Kasuni, 5 December.

STREPTOPELIA LUGENS (Rüppell)

I have examined a specimen from Mwanda hill collected by Button.

TYMPANISTRIA TYMPANISTRIA FRASERI Bonaparte

♂ ♀, Jombo, 5,000 feet, 10 and 5 August (MCZ)

C/2 h.i., Malawi, two miles west of Port Herald, 2,000 feet, 20 February (P), C/2 also seen at Soche, 1 January. Lennon saw a nest with two young at Zomba, 1 July.

CUCULUS SOLITARIUS Stephens

See remarks under *Cossypha heuglini*

PACHYCOCCYX AUDEBERTI VALIDUS (Reichenow)

In open *Brachystegia* or *mopane* woodland, or dense riparian scrub, noticed as follows: Chikwawa, 6 February, 8 August, 20, 22 and 24

September, 14 December; Kotakota, 25 September; Karonga, 12 July. In view of these records, additional to those given by Belcher, and in the Ibis (1934: 759; 1944: 453) perhaps this bird is resident. In regard to catholicity of habitat and lack of migratory movement, these data confirm those given by Friedmann (1948: 100) for Africa as a whole. *P. a. canescens* a synonym, see Bull. Brit. Orn. Cl., **57**, 1937: 104.

CLAMATOR CAFER (Lichtenstein) and CLAMATOR JACOBINUS SERRATUS (Sparrman)

For these names see Ibis (1937: 405)

A bird with white underside, quivering its wings as if begging for food, was seen with a party of *Turdoides jardinei* at Liwonde, 7 April. The bird was actually fed in an otherwise similar observation made at Vintukhutu, 16 February.

From their size, these birds were considered to be *C. jacobinus.* An observation similar to the Vintukutu one was made near Fort Hill, 19 May, but in this case the bird being fed seemed larger, and therefore more likely to be *C. cafer.* It had no heavy streaking on the throat and breast as in adult *cafer*, but neither has a specimen definitely referable to *cafer* that was collected by Macpherson on Namitete River, 3,500 feet, 26 March. Friedmann (1948: 51) regards such indistinct streaking as a juvenal characteristic.

There is no previous record of the black form of *C. jacobinus* in Nyasaland, but Fitzmaurice saw two birds near Fort Johnston, 16 March, which he says differed in no way from the plate of *Melanolophus serratus* (Roberts, "The Birds of South Africa," plate 23) except that the tail feathers were tipped with white. Also, in his original notes, Paget-Wilkes refers to "two crested cuckoos, all black with a white wing-bar," seen flying excitedly around a nest of *Turdoides jardinei* containing eggs near Monkey Bay, 27 November. In both instances the species is far more likely to have been *C. jacobinus* than *C. cafer*, the black phase of which is known only from coastal Kenya Colony (Ibis, 1947: 519). From the dates, and in the latter case, the circumstances, they may well have been locally breeding birds. In the British Museum there are six specimens of the grey form of *C. jacobinus* from Nyasaland, collected between November and February, and seven of the light form from Nyasaland and eastern Northern Rhodesia, of which one was taken in November, one in February, three in March and two in April.

CENTROPUS TOULOU GRILLII Hartlaub

♀, Karonga, 3 April (Transvaal Museum)

Eggs much enlarged and yolking in ovary. The rapid 'popop' call (Ibis, 1940: 403) is frequent, but the only occasion on which I have heard a call, very like the "full call' (Ibis, 1947: 642), was on the Vwaza Marsh, 5 February.

CENTROPUS SUPERCILIOSUS

♂, Tembwe, 18 April (MCZ)
♀, Mpanyankunda, 25 April (MCZ)
Both these birds are referable to *C. s. loandae* C. Grant

Belcher gives egg-laying in the Shire Highlands as from October to January and records eggs from Fort Johnston, 26 June. He states (*in litt.*) that though he saw paired birds at Zomba as early as mid-September, he did not find eggs before December. According to his egg-register, Paget-Wilkes took fresh clutches at Dzunje as follows: C/4, 11 December; C/3, 21 February; C/3, 23 March; C/5, 2 April; C/3, 9 June. Lennon gives the following data from Zomba: N/4, 22 January; C/2 f., 12 January, this complete clutch of four hatched 31 January; N/3, 2 March.

All the foregoing records probably refer to *C. superciliosus burchellii* Swainson, judging by what we know from specimens of the occurrence of *C. monachus*, *C. superciliosus*, and *C. senegalensis* in Nyasaland (Ibis, 1940: 403; 1942: 213; Ann. Transvaal Mus., **21** (2), 1949: 165; Bull. Brit. Orn. Cl., **68**, 1948: 127). Further data: N/1, Karonga, 11 March, *C. s. loandae*; C/3 hatching, Chinteche, 13 March, probably *C. s. burchellii*, which was obtained in this locality.

TAURACO SCHALOWI MARUNGENSIS (Reichenow)

♂, Jombo, 6,000 feet, 10 August (MCZ)
♂, Mwanjati, 17 June (MCZ)

According to his egg-register, Paget-Wilkes took C/2 f. clutches at Dzunje as follows: 20 November; 2 and 12 December. These are the data on which the breeding notes given in Ibis (1928: 734; 1930: 447) are based, and which are from within the range of *T. schalowi*, not of *T. livingstonii*. N/2 almost ready to leave nest, were seen on the Vipya, 11 January. For reference see Ibis (1943: 388).

GALLIREX PORPHYREOLOPHUS CHLOROCHLAMYS Shelley

♂ ♀, Jombo, 4,500 feet, 4 August (MCZ)

MUSOPHAGA ROSSAE ROSSAE Gould

(See Chapin, "Birds of the Belgian Congo," **2**, 1939: 230.)
♀, Muzyatama, 11 May (MCZ)

HALCYON LEUCOCEPHALA PALLIDIVENTRIS Cabanis

♂ ♂, Tembwe, 20–21 April (MCZ)

Regarded (Ibis, 1940: 411) as migratory, and further experience confirms this, though occasionally noticed in the second half of September. Baird saw one at Monkey Bay, 3 June, and Zomba, 8 July, but such dates are most unusual.

HALCYON SENEGALENSIS CYANOLEUCA (Vieillot)

♂, Tembwe, 21 April (MCZ)

The breeding records given in the Ibis (1928: 738) are open to considerable doubt. A nest is recorded as early as 30 August, nesting said to be in banks. (See Ibis, 1940: 410; 1942: 216; 1944: 455; Ool. Record, **21** (4), 1947: 5), which reveals this Kingfisher as a migrant that does not arrive in Nyasaland until November, and breeds in holes in trees.

HALCYON CHELICUTI CHELICUTI (Stanley)

Glynn reports two nestlings in a nest of *Hirundo abyssinica* on the veranda of his house at Kotakota in December. Nestlings were also noticed there 11 October, in the same site as mentioned in the Ibis (1942: 216).

MEROPS NUBICUS NUBICOIDES Des Murs and Pucheran

♂ ♀, Muliro, 31 July (MCZ)

One seen at Mzimba, 21 March; a stray bird like that recorded in the Ibis (1942: 217).

BYCANISTES BUCINATOR (Temminck)

(For reason for binomial see Bull. Brit. Orn. Cl., **67**, 1946–47: 11.)
♂, 1 Sex ?, Jombo, 3,000 feet, 9 and 11 August (MCZ)

TOCKUS PALLIDIROSTRIS NEUMANNI (Reichenow)

♀, Mzimba, 15 October (MCZ)
containing one nearly completely formed egg and C/3 already laid (P)

Eggs white, rough-surfaced, dull, minutely and plentifully pitted all over; size 37.2 x 26.8, 35.9 x 26.5, 35.4 x 26.1 mm. Parent with remiges and rectrices still complete. Nesting-hole 15 feet above ground, in a 40-foot high *Brachystegia* tree. Hole one foot deep, four inches wide; diameter of circular entrance four inches, but sealed so as to leave a narrow slit only half an inch wide. It was already sealed thus, and the parent inside, but no eggs yet laid, on 9 October. The sealing-material was entirely removed by me, and had been completely replaced with fresh material by 15 October. The combined weight of the two sets of sealings was 94 grammes. I am indebted to Mr. A. W. McKenny-Hughes, of the entomological department of the British Museum, who has furnished the following report on this material: a conglomerate of regurgitated animal and vegetable matter, impossible to determine precisely, though containing remains of small beetles and at least one cockroach, small bits of seeds, fractions of stems and the like.

PHOENICULUS PURPUREUS MARWITZI (Reichenow)

A nesting-hole, containing two eggs and two young just hatched, was found in *Brachystegia* woodland at Mzimba, 9 October. Two days later all the young were hatched. They were covered in white curly down protruding about 5 mm. from the surface of the body. Interior of mouth dull flesh colour; gape conspicuous white.

According to his egg-register, Paget-Wilkes took clutches at Dzunje as follows: C/5, 24 September; C/3, 22 October; C/4, 15 November.

RHINOPOMASTUS CYANOMELAS SCHALOWI Neumann

C/1 f., Mzimba, 16 October (P)

Egg light, bright blue, well glossed, very finely pitted all over but scarcely perceptible except with a lens; size 20.6 x 15.6 mm.

BUBO AFRICANUS AFRICANUS (Temminck)

♀, 40 miles northwest of Fort Hill, 16 May (MCZ)

Killed at night on a bare earth car-track where this species is often noticed, throughout Nyasaland. The stomach contained grasshoppers.

CAPRIMULGUS PECTORALIS FERVIDUS Sharpe

♂, 10 miles northeast of Mzimba, 5,000 feet, 3 December (MCZ)

Gonads enlarged and flabby, probably recently bred. Contrary to the records given in the Ibis (1940: 420), in 1948 these nightjars were heard calling at Mzimba throughout October, even until 16 November. Probably resident, though entirely silent in December and January (Ibis, 1942: 221). Calling in February unusual though heard at Zomba, 11 February; Mzimba, 26 February.

SEMEÏOPHORUS VEXILLARIUS Gould

A young bird, resembling the adult female in colour, was seen at Mzimba on 12 November. Wing 96 mm., not yet able to fly. When menaced by a dog, it opened wide its pale pink mouth. While I was handling the chick the female parent kept within ten yards, flying low over the ground for about four wing-beats, then settling for a few seconds with wings outspread before repeating its flight. Two young seen the same day, and probably less than a week old, were black above, with head buffy, and underside pale buffy. The female parent remained some twenty yards away but did not indulge in "injury-feigning." The contrast in the colour of these two young and that of the eggs is striking. The latter harmonize well with the red soil on which they are usually laid, if the soil is not yet blackened by fire. But these two young seem better adapted to blackened soil (Ibis, 1946: 317). Belcher writes of the habitat as rocky, timbered country. I find it to be typically open *Brachystegia* woodland, the ground often stony, but not usually where there are rock-slabs, as with *Caprimulgus tristigma*. The record from the Nyika Plateau (Ibis, 1942: 222), was doubtless of a bird still on migration. I agree with Belcher that the males arrive with pennants fully developed, rather than with Paget-Wilkes (Ibis, 1928: 745), that they are grown during the breeding season. I have not seen males with pennants broken or absent earlier than late November. But I agree with Paget-Wilkes that incubation is by the female only.

Breeding dates additional to those already published: C/2 h.i., Blantyre, 21 October, showing up conspicuously on blackened soil over which a fire had recently passed; C/1 h.i., Ncheu, 29 October; C/1 f., 13 and 29 October; C/2, 7 October; C/1 f., 15 November; all four at Mzimba. Some of the records given in the Ibis (1928: 745; 1930: 452) may refer to a *Caprimulgus* sp., since the female is mentioned as having white wing-spots, which in fact that of *semiophorus* lacks.

COLIUS STRIATUS BERLEPSCHI Hartert

C/2 f., Vipya, 14 December (P)

A third egg got broken. Eggs dull white, roughish matt surface; size 21.2 x 17.2, 21.4 x 17.3 mm. Nest eight feet above ground in tangled secondary growth on edge of evergreen forest.

The observations given (Ibis 1928: 746), may be referable to *C. indicus*, which is common in the lower levels of the area worked by Paget-Wilkes, whereas *C. striatus* is most rare in all parts of the area.

TRICHOLAEMA DIADEMATUM FRONTATUM (Cabanis)

♀, Kolala, 9 May (MCZ)
C/3 h.i., Mzimba, 11 October (P)

Eggs in a hole whose entrance was four feet from the top of a dead 25-foot high tree in *Brachystegia* woodland. Hole five inches deep, entrance neatly chiselled. Width of hole and of entrance three inches. Eggs white, rather oblate, dull surfaced, somewhat nest-stained; size 20.3 x 14.4, 21.0 x 15.2, 20.9 x 15.3 mm.

POGONIULIUS BILINEATUS BILINEATUS (Sundevall)

1 Sex ?, Mwanjati, 17 June (MCZ)

TRACHYPHONUS VAILLANTII VAILLANTII Ranzani

C/4 hatching seen in *Brachystegia* woodland at Mzimba, 10 October. Entrance to nesting — hole ten feet from ground in a dead 15-foot high stump. Entrance vertically oval, 2½ x 1½ inches, with no sign of chiselling by the parents (compare with *Tricholaema* above, for example, which has a stronger bill). Hole two feet deep. Eggs white, slightly glossy, smooth-surfaced; size approximately 27 x 17 mm. Near the nest a bird, presumably the male, was calling as described in the

Ibis (1948: 391); another, presumably the female, was calling simultaneously, or sometimes independently, with a less high-pitched (some four tones lower) more deliberate, less prolonged note.

PRODOTISCUS sp.

See under *Campethera bennettii*

CAMPETHERA BENNETTII BENNETTII (Smith)

♀, *Brachystegia* woodland near Mzimba, 13 October (MCZ)
with C/1 f. (P)

The female held an almost fully developed egg. The one already laid is very small for this species, measuring only 18.4 x 15.3 mm. (Ibis, 1946: 325). It is white, well glossed, bluntly oblate. In this locality and environment the only possible parasites that might be concerned are *Indicator indicator, I. minor, Prodotiscus regulus,* and *P. insignis*. According to the measurements given in the Ostrich (1939: 100 105) one of the *Prodotiscus* is most likely, and of these only *P. insignis* has been observed in the actual vicinity of Mzimba.

DENDROPICOS FUSCESCENS CAMACUPAE Bowen

♀, Hoho, 20 miles south-south-east of Mzimba, 4,500 feet, 20 June (MCZ)

The racial name employed is in accordance with reasons given in the Ibis (1947: 611).

THRIPIAS NAMAQUUS NAMAQUUS (Lichtenstein)

♂, Katambara, 7 May (MCZ)

SMITHORNIS CAPENSIS CAPENSIS (Smith)

♀, Kolala, 9 May (MCZ)

MIRAFRA RUFOCINNAMOMEA ZOMBAE Ogilvie-Grant

♂♂, ♀, Muliro, 1 August (MCZ)
♂, Mzimba, 14 September (MCZ)

For nomenclature see Bull. Brit. Orn. Cl., **66**, 1945: 14.

ANTHUS RICHARDI LICHENYA Vincent

♂, Lake Kasuni, 28 November (MCZ)
♀, with C/3 f., Nyika, 3 November (MCZ)

(Racial name is in accordance with Bull. Brit. Orn. Cl., **67**, 1946: 9).

Other breeding records: C/3 f., N/2 (and one infertile egg), both at Blantyre, 4 October; N/1 soon to fly (with one infertile egg), Vipya, 14 December.

ANTHUS LEUCOPHRYS BÖHNDORFFI Neumann

♂ ♀, River Songwe, 1,600 feet, 26 October and 2 November (BM)

This is the species to be expected in this high rainfall area (Ann. Transvaal Mus., **21** (2), 1949: 156), not *A. vaalensis* (Ibis, 1948: 550).

PSEUDOALCIPPE STIERLINGI STICTIGULA (Shelley)

♂, with C/2 h.i., Nyika, 3 November (MCZ)

For nomenclature see Bull. Brit. Orn. Cl., **55**, 1934: 45.

Eggs badly damaged, cream, very slightly glossed, plentifully and finely freckled all over with very pale brown, in one egg almost invisible, with a zone of concentration near large end, on underlying very pale grey; size approximately 21.5 x 14.5 mm. Nest four feet above the ground in a bush inside evergreen forest. A shallow, rather flimsy, but neat, open cup, made of spiralling tendrils and fine twigs 0.5-1 mm. thick, lined with very fine, hair-like, chestnut-coloured fibres. Diameter, external 100 mm., internal 60 mm.; depth, external 40 mm., internal 20 mm.

ATIMASTILLAS FLAVICOLLIS PALLIDIGULA Sharpe

♀, Kolala, 8 May (MCZ)

PHYLLASTREPHUS TERRESTRIS SUAHELICUS Reichenow

3 ♂♂, Jombo, 3,000 feet, 4–9 August (MCZ)
♂, Njakwa, 7 September (MCZ)

PHYLLASTREPHUS FISCHERI CABANISI (Sharpe)

♂, Kolala, 8 May (BM)
♂, Muzyatama, 11 May (MCZ)

For use of this name instead of *P. f. sylvicultor*, see Ibis (1945: 544)

PHYLLASTREPHUS FISCHERI PLACIDUS (Shelley)

♂, Mwanjati, 15 June (MCZ)

PHYLLASTREPHUS FLAVOSTRIATUS ALFREDI (Shelley)

C/1 f., Nyika, 13 November (MCZ)

No parent was collected or observed with this egg, but it resembles in general pattern the very distinctive eggs of *P. f. vincenti* (Ibis, 1947: 282). Nor does it markedly differ from Belcher's description of the eggs of *P. f. alfredi* to which it may be safely attributed. Ground-colour greyish-mauve, slightly glossy, which examination under a lens shows to be due to intense minute stippling of this colour all over on white; markings, of very dark sepia and rich chestnut on underlying bluish-grey, are restricted to a zone near the larger end; size 22.5 x 15.5 mm.

The nest, reported as six and a half feet above the ground, is suspended in the fork of a twig about four mm. thick. It is an open cup, not markedly dissimilar to that described by Belcher. It is made of very fine creepers and brown grass, interwoven with dry leaves and paper-like bark, decorated outside with a little green moss, lined inside with very fine rufous fibres. Diameter, external 100 mm., internal 50 mm.; depth, external 50 mm., internal 20 mm.

Vincent (Bull. Brit. Orn. Cl., **53**, 1933: 133–5) describes both *P. f. litoralis* and *P. a. itoculo* from Netia, Mozambique, and so concludes that *P. flavostriatus* and *P. alfredi* cannot be conspecific, thus disagreeing with Sclater. Grant and Praed (Bull. Brit. Orn. Cl., **60**, 1940: 52) place *P. a. itoculo* as a synonym of *P. münzneri*, and (*op. cit.*: 62–3) describe *P. f. vincenti*, also placing *P. f. litoralis* as a synonym of *P. f. tenuirostris*. Moreau (Bull. Brit. Orn. Cl., **67**, 1947: 90) places *P. münzneri* as a race of *P. fischeri*.

While not overlooking localities given in the Ibis (1943: 390) I can find no record of an overlap in distribution between *P. alfredi* and *P. flavostriatus*, and I prefer to follow Sclater in regarding them as conspecific, as indeed I have already done (Ibis, 1948: 65; and Ann. Transvaal Mus. **21** (2), 1949: 157–8) but inadvertently omitted to do (Bull. Brit. Orn. Cl., **69**, 1949: 59). In Nyasaland I fail to see any difference between them in general habits and voice, and as already indicated above, their eggs are closely similar in colour pattern.

ARIZELOCICHLA TEPHROLAEMA FUSCICEPS (Shelley)

♀ ♀, Mwanjati, 21 June and 22 September (MCZ)
♀, with C/2 f., Nyika, 1 November (MCZ)

The specific name employed above is in accordance with the Ibis (1943: 391).

Parent and eggs taken by my collector unsupervised, but correlation apparently correct. Parent with small ova, no more eggs to be laid. Eggs somewhat oblate, white, slightly glossed, very heavily freckled with purplish-brown (more brightly in smaller egg) on underlying greyish-lilac, so heavily at the larger end that the white ground is practically obscured; size 26.9 x 18.3, 25.7 x 17.9 mm. Nest an open cup made of long, slender, creeper-like twigs, 0.5–1 mm. thick, coarse grass-blades and dried leaves, covered outside with moss, lined with very fine, hair-like, chestnut-coloured fibres. Diameter, external 120 mm., internal 65 mm.; depth, external 95 mm., internal 45 mm.

A call frequently heard is a chattering note, "twuk, . . ." repeated up to twelve times, very like that of *A. milanjensis* (Ibis, 1948: 67). In October and November, on the Vipya and Nyika, a song-call was very frequent — a single "pi-chu" or sometimes "hor-pi-chu" ("pi" emphatic, "hor" not loud).

ARIZELOCICHLA MILANJENSIS STRIIFACIES (Reichenow and Neumann)

♂, Mwanjati, 21 June (MCZ)

EURILLAS VIRENS ZOMBENSIS Shelley

♀, Kolala, 8 May (MCZ)
♂ ♀, Jombo, 5,000 feet, 7 August (MCZ)

The racial name is in accordance with Bull. Brit. Orn. Cl., **60**, 1940: 64.

MUSCICAPA ALBICOLLIS Temminck

I have examined a male in full pied dress, collected by Button at Lundazi, 29 January. A bird in female-like dress seen at Mzimba, 8 January, and at Hora, 15 miles north of Mzimba, 24 February. This bird appears to be a regular visitor in small numbers as far south as this part of Africa. See also Ibis (1938: 274; 1944: 460; 1947: 559; 1948: 392). The generic name is in accordance with Ibis, 1948: 320.

PARISOMA PLUMBEUM ORIENTALE Reichenow and Neumann

♂, Kolala, 9 May (MCZ)

BRADORNIS PALLIDUS SUBALARIS Sharpe

C/3 f., Mzimba, 24 October (MCZ)
C/3 h.i., Blantyre, 4 November (P)

The racial name is in accordance with Bull. Brit. Orn. Cl., **68**, 1948: 99.

DIOPTRORNIS CHOCOLATINUS NYIKENSIS (Shelley)

♂ ♀, Mwanjati, 28 September (MCZ)

The specific name is in accordance with Ibis, 1946: 181.

MELAENORNIS PAMMELAINA PAMMELAINA (Stanley)

C/3 s.i., Mzimba, 13 October (MCZ)
C/1 f., Thambani, 3,000 feet, 25 miles south-west of Neno, 12 October (P)
C/3 f., Blantyre, 4 November (P)

Analysis of nests referred to in Ibis (1942: 308): two C/3, Ncheu, 9 and 24 October; C/3, Edingeni, 29 September; N/3, Emfeni, 23 October. C/3 also seen at Njakwa, 12 December. According to his egg-register, Paget-Wilkes took twenty-two clutches (four C/2, eighteen C/3) at Dzunje, all in October, except for one on 28 September and one on 25 November.

MYOPORNIS BÖHMI BÖHMI (Reichenow)

♂ ♀, Kolala, 9 May (MCZ)
♀, Mzimba, 24 October (BM)
C/3 f., Mzimba, 10 October (MCZ)
C/4 f., Mzimba, 24 October (P)

The stomach-contents of the Mzimba specimen were examined by Professor J. Omer-Cooper, of Rhodes University, Grahamstown, who writes that there were well-digested fragments of beetles, also lepidopterous scales and a fly antenna. This species is on the whole very silent, though at dusk a faint "siiiii" has been heard, inaudible at a distance of more than 50 yards. Eggs reminiscent of those of *Sigelus silens*. Pale green, slightly glossed, indistinctly suffused all over with faint specks and streaks of very pale chestnut, showing a tendency to concentrate at top of large end. Evidently very similar to those described in the Ibis (1947: 179); size: C/4, 19.4 x 14.0, 19.4 x 14.3, 19.3 x 14.2, 19.3 x 14.3 mm. C/3, 19.6 x 14.2, 19.7 x 14.3, 19.2 x 14.0 mm. Another C/3 fresh, seen at Mzimba, 14 October, was smashed. All three clutches were in old nests of *Plocepasser rufoscapulatus* situated in open *Brachystegia* woodland (Ibis, 1937: 580; 1940: 599). Nests lined, presumably by the tenants, with white silken vegetable-down in the innermost part of the interior chamber, where the eggs lay.

For use of trinomials see Ibis, 1940: 598.

HYLIOTA FLAVIGASTER BARBOZAE Hartlaub

♀, Kolala, 9 May (MCZ)

BATIS CAPENSIS DIMORPHA Shelley

♀, Mwanjati, 15 June (MCZ)

PLATYSTEIRA PELTATA PELTATA Sundevall

♀, Jombo, 4,500 feet, 5 August (MCZ)

TROCHOCERCUS ALBONOTATUS ALBONOTATUS Sharpe

♂, Mwanjati, 22 September (MCZ)
N/2, Nyika, 18 November (MCZ)
C/2, Ndirande, 19 October (P)

Nestlings already feathered, dark slate (crown no darker), centre of abdomen white. Nest as described by Belcher, though a few very fine, hair-like, chestnut-coloured fibres had been loosely superimposed on the lichen as a lining. There is also some decoration of spider-web on the outside. One wall is completely built around, and supported by, an upright twig about 5 mm. thick. Diameter, external 60 mm., internal 40 mm.; depth, external 80 mm., internal 30 mm. The date for nestlings given in the Ibis (1942: 310), should read 13 November, not 31 November. An almost completely fresh nest was seen at Ndirande, 3 September, and my collector reported a fledgling still being fed by its parents at Soche, 15 March.

TURDUS LIBONYANUS TROPICALIS Peters

C/3 f., Katete, 1 October (MCZ)

The racial name is in accordance with Bull. Brit. Orn. Cl., 61, 1940: 6.

Turdus olivaceus nyikae Reichenow

♀, with C/2 f., Nyika, 30 October (MCZ)

Eggs pale blue, plentifully freckled with red-brown on underlying pale lilac that almost obscures the ground-colour in one egg; size 30.6 x 20.3, 30.9 x 20.3 mm. The nest was seven feet from the ground on the truncated stem of a tree-fern in evergreen gully forest. An open cup compactly constructed of leaf-skeletons bound with fern-rootlets, moss and small fern-leaves, lined with very fine hair-like grass. Diameter, external 125 mm., internal 65 mm.; depth, external 70 mm., internal 35 mm. See also Loveridge (Bull. Mus. Comp. Zoöl., **25**, 1933: 192). Young found nestlings about to fly, Nyankhowa, 10 January.

Monticola angolensis (Sousa)

♀, C/2 f., C/3 f., Katete, 28 September (MCZ)

Oenanthe oenanthe oenanthe (Linné)

♀, Vipya, 17 October (MCZ)

Wing 96 mm. Single birds of this species were seen regularly in this locality, October and November; and also noticed at Mzimba on 11 January, 30 September, and at Lake Kasuni, 28 November. A specimen of this race collected by Loveridge on the Nyika was also examined. In view of these records and those given in the Ibis (1937: 565; 1940: 605; 1942: 311) small numbers of *O. oenanthe* may be regarded as regular visitors as far south as Nyasaland.

Thamnolea arnotti arnotti (Tristram)

C/3 s.i., near Katumbi, 31 October (P)

Eggs respectively pale blue, light blue tinged with green, and pale greenish; marked with pale chestnut and pale rufous on underlying pale lilac-grey, mauve and faint purplish-grey; markings sparse except for a broad zone of concentration, not quite forming a cap, at the top; shape rather oblate; size 22.3 x 16.2, 22.3 x 15.6, 21.5 x 15.6 mm. Nest situated at the bottom of a cleft in a tree (*Copaifera mopane*). Bottom of the cleft was three feet from the ground, four inches in diameter, tapering to nothing six inches higher. Bottom of cleft covered by the base of the nest, a mere pad of fine twigs, on which was superimposed coarse grass, topped by about forty breast-feathers, mostly those of

Numida mitrata and *Streptopelia capicola.* Two other nesting sites in *Brachystegia* woodland were examined on the same day in the same locality. One contained four recently hatched young, in a hole eight feet from the ground in a 12-foot high decayed stump. The entrance was of irregular shape, averaging two and a half inches in diameter and one inch from its lowest point to the bottom of the hole. The other site, generally similar, contained two young already able to flutter along the ground. They were black; wings white, except for black primaries and secondaries; coverts tipped with black for 5 mm.; bastard-wing black; mouth orange-yellow, gape yellow; wings 69, 72 mm.

According to his register, Paget-Wilkes took the following clutches at Dzunje: C/3, 10 October; C/1, 17 October; C/3, 18 October; C/3, 22 November. In the last two incubation was advanced.

One bird was seen twenty miles east-north-east of Emfeni, at 2,500 feet, 16 June, and I have seen a specimen collected by Button ten miles south of Mkocha, at 4,000 feet.

COSSYPHA HEUGLINI HEUGLINI Hartlaub

♂, Katete, 22 September (MCZ)
C/2, both s.i., Vipya, 13 November (MCZ)

One egg is milk-coffee in colour; size 23.0 x 16.9 mm. The other is much less richly coloured, with a distinct greyish tinge; size 22.5 x 16.4 mm. If it is of a parasite, this is almost certainly *Cuculus solitarius*, which is common in this locality, and with the egg of which it agrees in colour, though rather smaller, see Friedmann: 68. No other species of *Cuculus* occurs there. The racial name is in accordance with Bull. Brit. Orn. Cl., **61**, 1940: 12.

COSSYPHA CAFFRA IOLAEMA Reichenow

♀, with C/3 f., Nyika, 8 November (MCZ)
C/3 f., Vipya, 25 November (MCZ)
C/2 h.i., Vipya, 14 December (MCZ)
C/2 f., Matipa, 15 November (P)

The Matipa eggs are immaculate pale blue, the others are of the more usual type, pale greenish or pale cream, finely and evenly freckled pale rufous. Also seen were: C/3 hatching and C/2, both Vipya, 3 November; N/1, Vipya, 14 December; N/2 soon to fly, Zomba, 25 December.

CICHLADUSA ARQUATA Peters

Turner saw parents feeding young in a nest in the eaves of his house at Karonga in December; and again in exactly the same place the following February.

SAXICOLA TORQUATA ORIENTALIS W. L. Sclater

♀, with C/3 m.i., Nyika, 3 November (MCZ)
C/3 f., Mwanjati, 30 September (MCZ)

The Nyika eggs are immaculate pale blue, those from Mwanjati faintly freckled with pale red-brown. Further data: N/2 just hatched, Blantyre, 17 November; C/3 hatching, Vipya, 13 November; C/4 Vipya, 14 November. The nest containing this last clutch was in a disused native earthenware pot lying on its side. The racial name is in accordance with Bull. Brit. Orn. Cl., **65**, 1944: 9.

ERYTHROPYGIA BARBATA (Finsch and Hartlaub)

C/3, Mzimba, 18 October (MCZ)

Nest and eggs in open *Brachystegia* woodland as described in the Ibis (1947: 561), though measuring 20.4 x 15.7, 20.5 x 16.2, and 20.8 x 15.9 mm. The first egg was laid 13 October and the clutch was completed 15 October. C/2 seen 25 October in the same locality and environment; nest level with the ground, but occupying entire diameter of a five-inch deep hollow in the bottom of a stump.

The binomial is in accordance with Bull. Brit. Orn. Cl., **67**, 1946: 32.

CALAMONASTES FASCIOLATUS STIERLINGI Reichenow

C/2 f., Mzimba, 25 October (MCZ)

Nest and eggs as described in Oological Record (**21** (4), 1947: 8) though nest only four feet above ground, and eggs finely spotted black and dark brown with hardly any underlying pale grey.

APALIS MURINA YOUNGI Kinnear

♂, with C/3 f., Nyika, 3 November (MCZ)
C/2 f., Vipya, 14 November (MCZ)
♂ ♀, Mwanjati, 15 and 21 June (MCZ)

Both nests were three to four feet from the ground on the edge of evergreen forest. Nests generally similar to that of *A. f. flavigularis*, see Belcher, also the Ibis (1947: text-figure 3; Ann. Transvaal Mus.,

21 (2), 1949: 171). Outside measurements are: overall height four and a half inches, greatest width three inches; vertically oval entrance one inch wide and one and a half inches high, its apex one and a half inches from top of nest. The Nyika nest has a thick wall of green moss interwoven with, and lined with, rufous, fibre-like, very slender stems. A few white composite seed-pappi are present on both the outside and inside. Eggs pale blue, evenly, rather coarsely, freckled all over with rufous on underlying faint slaty maroon; size 17.9 x 12.9, 18.2 x 12.9, 18.3 x 12.4 mm. The Vipya nest is composed of very slender, fibre-like stems, thinly covered outside with green moss and *Usnea barbata*, and thinly lined inside with silken asclepiad seed-pappi. Eggs white, finely freckled all over with rufous, some very pale, markings concentrated at large end; size 17.2 x 13.2, 16.9 x 12.9 mm. Although these two clutches are very different in appearance, their identification is undoubtedly correct. For reference see Ibis (1938: 528–533; 1940: 622–624).

A. m. youngi is now known in Nyasaland from Mwanjati north to Mzumara, and from the Nyika Plateau. Grant and Praed (Bull. Brit. Orn. Cl., **62**, 1941: 32, as amended, *ibid*, 1942: 69), also record it from the Ufipa Plateau in south-western Tanganyika Territory (see also Ibis, 1943: 393). I have examined the four specimens to which they refer, and agree that they cannot be separated from that race. In view of the occurrence of *A. m. murina* in both the Mafinga and Masuku Mts. (Ibis, 1940: 622, and Ann. Transvaal Mus., **21** (2), 1949: 171), this is most surprising. Grant and Praed suggest the possibility of *A. m. youngi* occurring in the Muchinga Mts., but my collector failed to obtain it there, and indeed in what appears to be the only other possible intervening locality providing the requisite environment — evergreen forest or scrub above 4,500 feet — *i.e.* the Mukutu Mts. (Bull. Brit. Orn. Cl., **69**, 1949: 59). *Apalis murina* is one of the easiest of evergreen forest birds to collect, and it is therefore unlikely it was overlooked. Incidently it is also undoubtedly absent from Mussissi Mt., between the Nyika Plateau and the Masuku Mts. (Ann. Transvaal Mus. **21** (2), 1949: 157–8).

No less remarkable is the distribution of *A. m. whitei* as given in the Ibis (1938: 533; 1945: 576; 1947: 230). It does not appear to occur in any intervening locality, and indeed at Mlosa, Zomba and Mlanje there occurs the analogous *A. f. flavigularis* (Ibis, 1940: 624). Having compared ten specimens of *A. m. whitei*, including three from Luwiri-Kitessi, with eleven of *A. m. murina*, from the Njombe district and northern Nyasaland, all in the British Museum, I find the only constant difference is that the mantle is a slightly paler grey in *A. m. whitei*. The colour of the head in *A. m. murina* is very variable.

APALIS MELANOCEPHALA LIGHTONI Roberts

Ad. ♂ ♀, 2 juv. Sex?, Soche, 25 December
♀, and 1 juv. (BM)
♂, and 1 juv. (MCZ)

For citation see Ostrich (1938: 119). Mr. Jack Vincent, M.B.E. (*in litt.*) queries the finding published in the Ibis (1948: 393) that *A. m. lightoni* occurs in southern Nyasaland from Mpingwe and Ndirande northwards to Namizimu, as well as at Mzimbiti, near Beira, Portuguese East Africa, with *A. m. fuliginosa* occupying intervening localities at Cholo and Mlanje. He suggests that this contradicts my finding (Ibis, 1944: 465) as indeed it does. The type of *A. m. lightoni* is in the Transvaal Museum; the topotypic Mzimbiti female (Ostrich, 1947: 127), inadvertently referred to as a male in 1948, is in the British Museum. I have again examined this specimen and compared it with a series of fourteen adult and sub-adult specimens from Soche north to Namizimu, including three adults from Mangoche. All fifteen specimens are in the British Museum, except the Soche male recorded above, and they include the one from Namizimu and one of the two from Mangoche recorded 1944. All are sexed as males, except the Mzimbiti bird, another female from Soche recorded above, and an unsexed bird from Namizimu. The two females do not differ from adult males in any way, except that the Soche bird is very slightly washed olive on the mantle. I find it impossible to separate the Mzimbiti bird racially from the Nyasaland birds. It differs in no way from six males, and the differences published in 1944, when only three Nyasaland specimens were available, cannot be regarded as racial. I consider the absence, or faint development, of a creamy wash on the throat and chest an indication of immaturity, that is also characterised by the upperside, except the crown, being washed with olive. The Mzimbiti bird, collected 7 February, and nine from Nyasaland, collected in March, May, September, October and December, may therefore be regarded as adult, and five others, collected in May, June and October, as immature or sub-adult. These age-differences are not altogether constant. Thus one of the sub-adults, although markedly olive above, has the creamy wash on the throat and chest well developed, and several of the adults, with no trace of olive above, have little or no creamy wash. These differences appear definitely to be due to age, and I find no evidence of their being seasonal.

The Soche juveniles recorded above, in which skull-ossification had not started, differ from both adults and sub-adults in being washed with yellow below; upperside including crown very strongly washed with olive; rectrices lacking any white tips and the basal half of lower mandible ochre, instead of the whole bill being black.

The Mzimbiti bird has a wing of 49 mm., compared with 49–52, average 50.5 mm., for Nyasaland birds. Its rectrices are very worn. Seven Nyasaland birds in which they are fresh, measure 61–68, average 65.2 mm.

The respective distributions of *A. m. lightoni* and *A. m. fuliginosa*, which is distinctly blacker above, are certainly perplexing. They are indeed found within 15 miles of each other, at Soche (*A. m. lightoni*) and Cholo (*A. m. fuliginosa*). I am unable to suggest any locality between those in Nyasaland and Mzimbiti where *A. m. lightoni* might be sought for. Evergreen forest is essential to the occurrence of the species. To the east of Cholo and Mlanje, Namuli Mt. is occupied by *A. m. tenebricosa*, while in Nyasaland west of the Shire Valley, although there are several possible localities, the species seems to be absent, as also from Malawi Hill, two miles west of Port Herald. This case is rather similar to that of *A. murina* discussed above, but is even more remarkable, since *A. m. lightoni* occurs in Nyasaland only above 4,000 feet, while Mzimbiti is practically at sea-level.

APALIS BAMENDAE BENSONI (Vincent)

Artisornis metopias bensoni Vincent, Bull. Brit. Orn. Cl., **55**, 1934: 174; but see **56**, 1936: 101; **57**, 1937: 105.

♀, Mwanjati, 22 September (MCZ)
♂♂, Isoko, Rungwe dist., Tanganyika Territory
(9°29′S, 33°30′E) 9 and 12 September (BM)

All these specimens have the dark throat of *A. b. bensoni*, while in a series of seven specimens of *A. b. strausae* from Njombe, Tanganyika Territory, in the British Museum, the throats of six are appreciably paler but that of one is as dark as in any Nyasaland specimen, of which I have examined twelve altogether. The juvenile from Chongoni (recorded in the Ibis, 1937: 570) not included above, differs from the adults in having the back, mantle and wing-coverts washed with brownish, the chest and abdomen washed with buffy, and the chin and throat much less richly coloured.

APALIS CHARIESSA MACPHERSONI Vincent

(See also Bull. Brit. Orn. Cl., **54**, 1934: 177, also **55**, 1935: 122)

Heard singing (Ibis, 1947: 288) in the Ruo Gorge, Mlanje, 3,500 feet.

EREMOMELA GRISEOFLAVA POLIOXANTHA Sharp

C/1 f., Mzimba, 22 October (P)

Nest as described by Belcher, quite unconcealed four feet from the ground in a six-foot high bush in secondary *Brachystegia* woodland. Egg white, dull surfaced, boldly and sparingly spotted with dull brown on underlying dull slaty-grey on top of larger end, elsewhere lightly specked; size 15.4 x 11.3 mm.

EREMOMELA SCOTOPS PULCHRA (Bocage)

♂, Jombo, 3,000 feet, 8 August (MCZ)

CISTICOLA LAIS SEMIFASCIATA (Reichenow)

C/1 f., Vipya, 13 November (MCZ)
C/3 h.i., Vipya, 14 December (P)
C/2 h.i., Vipya, 4 January (P)

N/2 just hatched also seen Vipya, 4 January.

CISTICOLA WOOSNAMI WOOSNAMI Ogilvie-Grant

♂, Kolala, 9 May (MCZ)
♂♂, Jombo, 4,500 feet, 13 August (MCZ)

HELIOLAIS ERYTHROPTERA RHODOPTERA (Shelley)

♂, Katete, 28 September (MCZ)
C/2 f., Zomba, 27 February (P)
C/2 m.i., Zomba, 2 April (P)

For remarks on the nests from which these eggs were taken see Ostrich (1946: 292). The racial name is in accordance with Bull. Brit. Orn. Cl., **62**, 1941: 15.

HIRUNDO RUSTICA LINNÉ

♀♀, Mzimba, 4 and 12 December (MCZ)

HIRUNDO ALBIGULARIS ALBIGULARIS Strickland

In his original notes, Paget-Wilkes records seeing one at the crossing of the River Shire near Matope, 18 July 1924. Considering that he already knew this species in South Africa (Ibis, 1924: 740) the record may be accepted. Chapin (*in litt.*) considers *H. a. microptera* Hartert of northern Angola a valid race, wing 121–124, tail (outermost rectrix) 58–63 mm., compared to wing 126–138, tail 68–77 mm. in South African birds. Measurements of specimens in the British Museum: Union of South Africa, 6 ♂♂, wing 126.5–133, tail 70–78 mm.; 16 ♀♀, wing 127–134, tail 66–77 mm.; 4 sex?, wing 125.5–133, tail 70–77 mm. Balovale, western Northern Rhodesia, 1♂ (6 July), wing 119, tail 60 mm. Measurements of those in the Transvaal Museum, all from South Africa: 5 ♂♂, wing 129–135, tail 74–79 mm.; 6 ♀♀, wing 126–131, tail 69–72 mm. The Nyasaland specimen recorded in the Ibis (1942: 318) has wing 128, tail 76 mm., and so is *H. a. albigularis*.

HIRUNDO GRISEOPYGA GRISEOPYGA Sundevall

Ad. ♂, juv. ♂ ♀, Mzimba, 26 August (MCZ)

The adult has somewhat enlarged gonads, indicating recent breeding. The juveniles, in which skull ossification had not started, and whose wings are only 79 mm., the outermost rectrices 41, 45 mm., differ from the adult in colour as follows: crown grey rather than brown; mantle and wing-coverts less glossy blue; tips of inner secondaries buffy-white; upper tail coverts more distinctly greyish and tipped with pale rufous. All three specimens were removed from a hole on Mzimba aerodrome. This hole, two inches in diameter, descended almost vertically for one foot before enlarging to form a chamber six inches in diameter, in which was a thin pad of fine grass.

In his register of specimens, Wood gives the following details regarding breeding at Port Herald: "7 September, 4 fresh eggs, few wisps of dried dhub-grass in chamber in large cracks in flat ground. 8 September, female caught on nest in chamber in cracks in flat ground covered with dhub-grass, male shot in air above: 4 eggs 2 slightly set, 2 fresher, almost certainly of 2 females using same nest." This amplifies and lends greater precision to Wood's record quoted in the Ibis (1941: 8) which refers to the same locality and date.

HIRUNDO ATROCAERULEA Sundevall

♀, with C/3 f., Nyika, 17 November (MCZ)

The nest, a shallow "saucer" of fine rootlets and grass, lined with soft white down-feathers, was placed on a "blob" of mud attached to the wall of an erosion-made cavity in the bank of a stream. The "blob" protruded about two inches at the top, was two inches in vertical thickness and tapered away at the bottom. Both the base of the nest and lower part of the cavity were sodden with water. Eggs white, very slightly glossed, plentifully spotted with reddish-brown and some underlying greyish-lilac, which tend to concentrate in a zone near the larger end; size 18.0 x 13.3, 18.0 x 13.3, 17.7 x 13.2 mm. The C/3 recorded in the Ibis (1942: 319) was moderately incubated.

Grant and Praed (Bull. Brit. Orn. Club, **62**, 1942: 43–45) in describing *H. a. lynesi*, find it resident in Southern Tanganyika Territory and Nyasaland. I find no evidence of this. Grant and Praed suggest that my earlier and latest dates require further investigation; presumably they refer to 30 October and 14 April in the Ibis (1941: 8). Even though I observed the species was already plentiful on the Nyika Plateau as early as 9 October, I still have no reason to suppose that *H. a. lynesi* is not a migrant. Considering Loveridge's specimen, recorded above, and fourteen others, all apparently adult, from southern Tanganyika Territory and Nyasaland, in the British Museum, eleven have some violet wash, characteristic of *H. a. lynesi*. There is no violet wash on the specimen collected by me on the Nyika, 7 November, which Grant and Praed refer to *H. a. atrocaerulea*, but which in view of the late date, is more probably an aberrant *H. a. lynesi*. A male collected by me on the Nyika on 9 October also lacks this wash, but it had gonads already enlarging so that probably it would have bred locally. I saw many others of the species there the same day, and there was nothing to suggest that they were migrating. A female collected Mlanje, 11 November, also lacks any violet wash.

There is little or no violet wash on a male from Tsangano Mt., Ncheu District, 12 October; or a male from Mlanje, 30 October; but a male from Woodbush, Transvaal, 10 December, is noticeably violet above. All these three males are in the Transvaal Museum. Thus of a total of 16 specimens from Nyasaland and southern Tanganyika Territory I have examined, 11 have no appreciable violet wash so that on a 75% convention *H. a. lynesi* is not recognizable.

HIRUNDO SEMIRUFA SEMIRUFA Sundevall

The only previous Nyasaland record is that given in the Ibis (1942: 319). I saw five in the same locality, early December, and two "hawking" over the Vwaza Marsh, 31 October. Twelve miles northwest of Ncheu, at 5,000 feet, 23 December, I saw a pair of *semirufa* with a pair of *H. daurica emini*, frequently fly beneath a stone culvert where they remained for several minutes at a time. There was one nest with a long spout apparently complete and another just started.

Unfortunately I could not stay long enough to determine which nest belonged to which pair.

HIRUNDO SENEGALENSIS MONTEIRI Hartlaub

♂ ♀, Katete, 30 September (MCZ)

A pair were seen building beneath the eaves of a brick trading-store at Mkocha, 30 September; a specimen noticed in Button's collection was taken at its nest at Lundazi, 5 February; a pair was seen at a nest in a brick building near Loudon, 16 February; pair seen at a nest in a baobab tree at Matope 15 May. All these records suggest breeding, though in no case was the nest examined as to possible contents.

RIPARIA CINCTA SUAHELICA van Someren

A male collected by Loveridge on the Nyika, 16 November, is of this race. It had "testes large." The specimen from Lake Chilwa recorded in the Ibis (1948: 393) is actually nearer this race rather than *R. c. cincta.*

CAMPEPHAGA SULPHURATA (Lichtenstein)

♀, Jombo, 3,000 feet, 7 August (MCZ)

The name *sulphurata* antedates *flava,* see Bull. Brit. Orn. Cl., **69,** 1948: 31.

SIGMODUS RETZII TRICOLOR (Gray)

♂, Mpanyankunda, 26 April (MCZ)

LANIUS MINOR Gmelin

♂, Mpanyankunda, 26 April (MCZ)

ANTICHROMUS MINUTUS ANCHIETAE (Bocage)

1 Sex ?, Mwanjati, 22 September (MCZ)

PARUS AFER GRISEIVENTRIS Reichenow

1 egg from C/4 f., Livingstonia, 15 October (MCZ)
C/4 f., Mzimba, 10 October (P)

The Mzimba clutch is from a hole, caused by decay in a 20-foot high dead tree in *Brachystegia* woodland. The hole, two inches in diameter and one foot deep, was situated at a fork twelve feet from the ground. At the bottom of the hole was a half-inch thick pad of fine mouse-grey hairs on which rested a little white wool-like material, and finally a few brown *Protea* seeds and some feathers. The parent bird sat very close and was almost caught by hand. Eggs white, plentifully spotted, dotted and freckled with reddish, rufous and chestnut, on underlying pale slaty-purple, pale lilac and pale purplish-grey; showing a tendency to concentration near the larger end; size 17.2 x 13.7, 17.0 x 13.4, 16.6 x 13.4, 16.3 x 13.3 mm. The Livingstonia egg was similar. The nest was in a crevice eighteen inches deep with the entrance six feet above ground, between the dead stems of a *Raphia* palm. Eggs rested on a little cotton-wool lying on a two-inch thick pad composed of pieces of bark and lichen.

The record (Ibis, 1941: 19) from Katunga on the Lower Shire cited by Belcher, is no doubt derived from the record of *P. parvirostris* in a paper (Ibis, 1901: 165) dealing with collections by Sharpe and Manning. I can trace no other record of a *P. afer* collected by Sharpe except in the Proc. Zool. Soc. London, 1900: 2, where no locality is given. I could find no specimen in the British Museum from Katunga, though there is one collected by Sharpe at Kasungu (reg. no. 1900.1.20.50). See also Bull. Brit. Orn. Cl., **69**, 1949: 85, for a number of instances of the locality Katunga being substituted for Kasungu. It is virtually certain that the same error was made in the present case.

P. a. parvirostris is a synonym; see Bull. Brit. Orn. Cl., **63**, 1942: 43.

PARUS NIGER Vieillot

♀, Tembwe, 20 April (MCZ)
♂ ♀, Mpanyankunda, 25 April (MCZ)

Grant and Praed (Bull. Brit. Orn. Cl., **63**, 1942–3: 44) are undoubtedly correct in regarding *P. niger* and *P. leucomelas* as separate species. I find an ecological difference between the two in Nyasaland. *P. niger* is typically a low-country species, occurring in drier types of forest where such trees as *Acacia albida* or *Copaifera mopane* are common, from sea-level up to 2,000 feet. It also occurs in the northern part of the Mzimba district at 3,000–3,500 feet, where these trees also occur, though in separate areas. *P. leucomelas* is rarely found below 4,000 feet, typically where *Brachystegia* woodland thins out at its junction with vleis or "dambos" (Ibis, 1940: 268) into scattered bushes and small trees. It occurs up to 5,500 feet in scattered low bushes on the open grasslands of the Vipya Plateau. It is not known in Nyasaland from the Highlands to the east of the Shire Valley and Lake Nyasa.

PARUS RUFIVENTRIS MASUKUENSIS Shelley

♂, ♀, Mzimba, 13 and 25 October (MCZ)
C/4 f., with above ♀ whose gonads showed no more eggs to be laid (P)

Nest hole in stump of an *Isoberlinia* tree where it had been chopped five feet from the ground. The hole, caused by decay, was of irregular shape but averaged two-and-a-half inches in diameter and eight inches deep. The bottom of this hole was lined with rufous-coloured pappi of *Protea* seeds which extended one inch up the sides. The eggs are similar to those of *P. afer* (see above) though their ground-colour is markedly creamy; size 17.3 x 13.4, 17.3 x 13.5, 16.9 x 13.6, 17.0 x 13.5 mm.

The type locality of *P. r. masukuensis* is given as "Masuku range, 7,000 feet." The distribution furnished by Sclater and by Belcher also gives the impression that it inhabits high mountain-plateaux. While conceivably it might occasionally wander up to such highlands, I have never found it there and find its true habitat is *Brachystegia* woodland at 1,600–5,000 feet (Ibis, 1941: 20; 1942: 324; Ann. Transvaal Mus., **21** (2), 1949: 173). Attention may be drawn to other cases of misleading information as to altitude which should be compared with the data given by Benson (Ibis, 1940–41); for example: (a) In the Ibis (1897: 518 554) the locality "Nyika" is frequently mentioned, in one instance (p. 528)being applied to country as low as 2,000 feet. But the term "Nyika" should only be used for the highland plateau at 7,000 8,000 feet, and none of the following numbered species in that paper would ever occur so high except possibly as occasional wanderers: 8, 11, 16, 18, 19, 24, 26, 27, 29, 30, 31, 35, 36, 42, 43, 45, 50, 53, 54, 59, 71, 78, 81, 82, 86, 87, 101, 105, 106, 107, 109, 110, 111, 121. The specimens recorded under number 11 (*Parus pallidiventris*) were subsequently named *P. r. masukuensis,* and the localities and altitudes given are the original source of misapprehension discussed above. Number 47 (*Laniarius fülleborni,* not *L. nigerrimus*) was far more likely to have been collected on the Nyika Plateau or the Masuku Mts. than at Karonga. (b) Similarly it is unlikely that any of the following numbered species recorded in the Ibis (1898: 376–381) from Mounts Zomba or Mlosa, or Zomba Plateau, *i.e.,* at 5,500 feet or higher, were obtained so high: 11, 13, 18, 19, 20, 21, 45, 47, 48, 63, 74, 80, 116.

ANTHOSCOPUS CAROLI ROBERTSI Haagner

C/5 (four s.i., one fertile), Mzimba, 19 October (MCZ)

Nest unconcealed, near the top of a fifteen-foot high *Diplorrhynchus* tree.

LAMPROTORNIS MEVESII MEVESII (Wahlberg)

♂♂, Tembwe, 17 April (MCZ)

BUPHAGUS AFRICANUS AFRICANUS Linné

Many were seen associated with a herd of about fifty buffalo near Katumbi, 31 October.

BUPHAGUS ERYTHRORHYNCHUS CAFFER Grote

♂, Mpanyankunda, 30 April (MCZ)

NECTARINIA JOHNSTONI SALVADORII Shelley

♂ ♀ (pair) with N/2 (C/2 24 hours previously) Nyika, 30 October (MCZ)
♂ ♀ (pair) with C/2 s.i., Nyika, 1 November (MCZ)

The only previous breeding record of this species seems to be that by Elliott and Fuggles-Couchman (Ibis, 1948: 423) for *N. j. johnstoni.* Both the Nyika nests were built about six feet from the ground in *Erica* bushes situated in a gulley. The two nests were within twenty-five yards of each other. They are made of fine heathoid twigs three or four inches long and, to a lesser extent, fine grass inflorescences; with a compact lining about half-an-inch thick of the rufous-coloured pappi of *Protea* seeds on which are scattered a few white pappi of composite seeds and, in one nest only, a few breast-feathers, probably those of *Francolinus levaillanti.* The rufous-coloured lining extends to the exterior rim of the entrance. Outside measurements are: overall height five inches, greatest width four inches; entrance one inch in diameter, its apex one and a half inches from the top of the nest; size 19 x 14 and 19 x 13 mm. respectively.

Eggs creamy white, very slightly glossed, plentifully marked all over with short scrawls and some dots of brown on underlying larger blotches of pale greyish-lilac, no zone of concentration noticeable. In one egg the markings are so plentiful as almost to obscure the white ground-colour and give it a generally darker appearance than the other.

NECTARINIA FAMOSA CUPREONITENS Shelley

Males in full breeding dress seen as far south as Mwanjati, 21 June. *N. f. aeneigularis* is a synonym, see Bull. Brit. Orn. Cl., **67**, 1947: 83.

NECTARINIA KILIMENSIS ARTURI P. L. Sclater

♀, Vipya, 4 July (MCZ)
C/1 f., Vipya, 11 July (P)

Egg white, faintly tinged with grey, boldly spotted and blotched at the large end with dull brown and grey-brown on heavy smears and blotches of pale slaty-grey; size 19.7 x 13.0 mm. Male as well as female seen at the unconcealed nest which was built ten feet from the ground, on the edge of evergreen forest. Nest made of fine grass stems, inflorescences, and fine rootlets; with a half-inch thick lining of *Clematis* seeds, each with its long feathery thread attached. Outside measurements are: overall height six inches, greatest width three and a half inches; circular entrance one inch in diameter, its apex two inches from top of nest.

Similar nests were seen in secondary bush adjoining evergreen forest in the same locality, 21 and 25 July. The former contained a single still naked young bird. The latter contained a single young one soon to be fledged, which was examined but not taken. Its bill was dull sepia, lower mandible paler; gape yellowish-white; interior of mouth orange; superciliary eye-stripe pale yellow; otherwise olive above, including the median and lesser wing-coverts; primaries and secondaries dull sepia; feathers of chin and throat still in sheath, but tips showing dull yellowish, chest dull olive, remainder of underside bright yellow; legs and feet grey; iris dark brown. Both parents kept "guard" on prominent perches about twenty yards from the nest, the male keeping up a continuous "peep."

These breeding dates differ considerably from those given (Ibis, 1908: 34) for Southern Rhodesia.

CINNYRIS BIFASCIATUS MICRORHYNCHUS Shelley

♂, Muliro, 1 August (MCZ)
♂, Sitwe, 25 July (MCZ)

The Muliro specimen is in full metallic dress with black belly; the Sitwe bird is moulting in the process of assuming it.

CINNYRIS CHALYBEUS

♂ *C. c. intermedius* Bocage, Kolala, 8 May (MCZ)

The subspecies are in accordance with Bull. Brit. Orn. Cl., **67**, 1947: 83–5.

The following breeding data refer to *C. c. bractiatus* Vincent: an occupied nest in the top of an iron telegraph pole, Blantyre, 14 October; nest with eggs at junction of wall with grass roof, District Commissioner's house, Ncheu, September; nest attached to outside of shade of an electric light on veranda of a house at Zomba, young hatched late in May. O'Riordan watched a female at Ncheu puncture the bases of large lily flowers so as to gain access to the nectar, as recorded by Belcher for *Chalcomitra senegalensis*. He confirmed his observation afterwards by finding tiny holes in the flowers.

CINNYRIS SHELLEYI SHELLEYI Alexander

♀, Muliro, 1 August (BM)

The females of *C. s. shelleyi*, *C. mariquensis suahelicus* and *C. bifasciatus microrhynchus* seem scarcely distinguishable except by size. That of *C. m. suahelicus* (this species does not appear to occur in Nyasaland or Portuguese East Africa) has wing 61–65 mm., and that of *C. b. microrhynchus* 48–56 mm. The only other females of *C. s. shelleyi* in the British Museum, both from Nyasaland, are: one from Kotakota (attributed to this species as it was collected with a male) and another also collected with a male from the Dzalanyama Mts. (Ibis, 1941: 30), where *C. b. microrhynchus* is unknown (it is most unusual to find it so high). These have wings 58, 59 mm., and the Muliro specimen also has wing 59 mm. The female recorded in the Ibis (1936: 66) is *C. cupreus* while that described in Bull. Brit. Orn. Cl., **8**, 1899: 54, has been identified by Captain Grant as *Chalcomitra amethystina*.

CHALCOMITRA SENEGALENSIS GUTTURALIS (Linné)[1]

Glynn records a nest in the mesh of the wire netting enclosing the veranda of his house at Blantyre. The nest was built into the large sized mesh which it fitted perfectly and had its entrance facing inwards towards the house; the eggs hatched in November. Another nest at Blantyre was attached to the under-surface of the roof of the veranda of a European dwelling house; the eggs hatched in September. Breeding in association with human dwellings is also recorded in the Ostrich (1946: 315).

CYANOMITRA OLIVACEA near LOWEI Vincent

♂, Muzyatama, 10 May (MCZ)

See the Ibis (1934: 91).

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[1] Regarding citation see Bull. Brit. Orn. Cl., **68**, 1948: 152.

XANTHOPHILUS XANTHOPS XANTHOPS (Hartlaub)

♀, Jombo, 4,500 feet, 11 August (MCZ)

The generic nomenclature of this and the two following species is in accordance with the Ibis (1946: 225–228).

PLOCEUS INTERMEDIUS CABANISII (Peters)

♂♂, Lake Kasuni, 28 November (MCZ)

Both in breeding dress with gonads enlarged (Ibis, 1949: 302), at a colony of about ten nests. Not recorded previously in Nyasaland from above the level of Lake Nyasa.

HYPHANTURGUS OLIVACEICEPS (Reichenow)

♂, Mwanjati, 17 June (MCZ)

COLIUSPASSER HARTLAUBI HARTLAUBI (Bocage)

♂ in full breeding dress, Katambara, 7 May (MCZ)

COLIUSPASSER HARTLAUBI PSAMMOCROMIUS (Reichenow)[1]

♀, with C/2 f., Nyika, 17 November (MCZ)

Nest, as described in the Ibis (1941: 38), loosely built of fine grass-stems, some with seeded heads. Outside measurements are: nest spherical with a diameter of five inches; diameter of entrance two inches. Eggs pale green, plentifully freckled all over with sepia and underlying pale greenish-lilac; size 22.3 x 16.2 and 23.4 x 15.9 mm. This 1948 record confirms the earlier breeding season of *psammocromius* as compared with those of other Nyasaland species of Whydah and Bishop-bird (Ibis, 1941: 38). Otherwise there is no evidence that the breeding seasons for birds as a whole is earlier on the Nyika than at lower altitudes. My collector obtained a male moulting into breeding dress on the Nyika, 4 October, 1947, but one week later all the many males I saw appeared to have completed their moult. See also the Ibis (1942: 331).

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[1] But perhaps best placed as a species, *C. psammocromius*, even though not known to overlap geographically with *C. hartlaubi*. The male in breeding dress of the former has the tail-feathers longer and narrower than in the latter, and this difference of width is also found in the female.

COLIUSPASSER ARDENS ARDENS (Boddaert)

♂ in non-breeding dress, 10 miles north-east of Mzimba, 5,500 feet, 25 November (MCZ)

SPERMESTES CUCULLATUS SCUTATUS Heuglin

♀, Mzimba, 7 December (MCZ)

ESTRILDA PERREINI PERREINI (Vieillot)

♂, Kolala, 9 May (MCZ)
♂, Muzyatama, 10 May (MCZ)

I have seen a specimen collected by Button on the River Chiri, near Mwanda Hill, and only about two miles from the Northern Rhodesia-Nyasaland boundary. But there is still no definite record from within Nyasaland. See also Bull. Brit. Orn. Cl., **67**, 1946: 36.

CRYPTOSPIZA REICHENOWI AUSTRALIS Shelley

♂, Mwanjati, 15 June (MCZ)

For nomenclature see Bull. Brit. Orn. Cl., **56**, 1936: 100.

LAGONOSTICTA RUBRICATA HAEMATOCEPHALA Neumann

♂, Mwanjati, 22 September (MCZ)

SERINUS CANICOLLIS SASSII Neumann

7 ♂♂, 6 ♀♀, all with gonads much enlarged, Nyika, 4–12 October (BM)
♂, with C/4 f., Nyika, 5 November (MCZ)
♀, with C/4 s.i., Nyika, 8 November (MCZ)
♀, with C/4, Nyika, 13 November (MCZ)

Eggs of the clutch taken on 5 November are white, hardly any gloss, spotted with dark chocolate and purple-brown on underlying greyish-lilac at large end only, one egg with some marked scrawling of dark chocolate; size 17.7 x 13.2, 18.0 x 13.3, 17.8 x 13.0, 18.2 x 13.1 mm. Those of 8 November are more glossy, with a faint tinge of blue, and sparingly marked with dark chocolate and pale red-brown, not strictly confined to the large end. Those of 13 November resemble those of 8 November but have hardly any gloss. In his original notes Loveridge recorded these last two clutches as C/4, but one egg was broken during removal from the nest, another while blowing. C/4 seems usual in Nyasaland (see Belcher, and Ibis 1941: 47). Each nest was built about six feet from the ground in a bush of *Philippia benguelensis*. Each nest was an open cup made of fine twigs and lined with rufous-coloured pappi of *Protea* seeds and some white pappi of composite seeds: Diameter, external 90 mm., internal 50 mm.; depth, external 40 mm., internal 20 mm.

Benson (Ibis, 1944: 479) regards *S. flavivertex* as conspecific with *S. canicollis* and I still adhere to this view. I have again compared Nyasaland specimens with South African, and also with a male (*S. c. thompsonae* Roberts) in the Transvaal Museum from Melsetter, Southern Rhodesia. This male is scarcely separable in the yellow colour of the underside and forehead from Nyasaland males. The feathers of the back are missing, but those of the mantle are no less conspicuously streaked than in Nyasaland males. It has the grey on the nape, hind-neck and sides of head which are entirely lacking in Nyasaland birds.

SUMMARY

The most important results are:

(a) Breeding data of various species are recorded, enabling a more precise assessment of their breeding seasons and clutch-sizes in Nyasaland. Nests and eggs are described in detail of those species or races about which little or nothing has been published. Those of the races *Pseudoalcippe stierlingi stictigula*, *Tricholaema diadematum frontatum*, *Parus rufiventris masukuensis* and *Nectarinia johnstoni salvadorii* do not appear to have been described at all. What was probably an egg of *Prodotiscus regulus* is described.

(b) *Phoeniconaias minor*, *Torgos tracheliotus*, *Neophron percnopterus*, *Circaëtus fasciolatus* and *Rhinoptilus cinctus* are rejected as ever occurring in Nyasaland on evidence so far adduced. For earlier rejections, see Bull. Brit. Orn. Cl., **67**, 1946: 36–38, and Ann. Transvaal Mus., **21** (2), 1949: 157. Kirk's records of *Glareola nordmanni* are also rejected.

(c) Some distributional peculiarities in certain races of *Apalis murina* and *A. melanocephala* are discussed.

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MAMMALS IN THE HIGHLANDS OF SOUTHERN PERU

By Oliver P. Pearson

Museum of Vertebrate Zoology, University of California
Berkeley, California

With Eight Plates

CAMBRIDGE, MASS., U. S. A.
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No. 3.—*Mammals in the Highlands of Southern Peru*

By Oliver P. Pearson

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  Other possible inhabitants 169

I have attempted in this account to describe the mammals, their environment, and their habits in a region almost unique for its great area at high altitude. Of special interest is Caccachara, one of the collecting locations discussed below, because it is the highest place at which an extensive study of mammalian life has been made. A key to the rodents of the highlands west of Lake Titicaca is given on page 132 for the convenience of ecologists, physiologists, or others who may find much to interest them in this strange region so easily accessible.

The specimens and notes upon which this report is based were collected by the Gardner Peruvian Expedition of the Museum of Comparative Zoölogy in 1939 and 1940, and by a second expedition in 1946. These expeditions, which I accompanied, remained in the highlands of southern Peru from November 29, 1939, to January 10, 1940, from April 1 to April 15, 1940, and from July 10 to December 17, 1946. I have also made use of the observations of my field companions: Anita Pearson, Allen Enders, George P. Gardner, Jr., and David Hertig. I wish to express here my indebtedness to them as well as to Alberto Eduardo de Amat and Jorge de Amat for many courtesies at Hacienda Pairumani, to Barbara Lawrence of the Museum of Comparative Zoölogy and to my wife for invaluable assistance in studying the collection and preparing the manuscript, and to G. H. H. Tate for assistance in going over a portion of the Peruvian collection in the American Museum of Natural History. Mr. C. C. Sanborn of the Chicago Natural History Museum has been of great assistance and has supplied many interesting observations from his unequalled knowledge of mammals of the altiplano. I am also grateful to the following individuals for identifications:

Francis Pennell	Academy of Natural Sciences of Philadelphia	— plants other than grasses
John and Charlotte Reeder	Yale University	— grasses
Charles Remington	Yale University	— insects
R. W. Strandtmann	University of Texas	— mites
Marietta Voge	University of California	— tapeworms
F. L. Werneck	Rio de Janeiro	— lice
G. W. Wharton	Duke University	— chiggers

I am especially indebted to Mr. George P. Gardner, Sr., whose support made possible my introduction to the Andes, and to George P. Gardner, Jr. who shared the hardships and pleasures that accompany learning the ways of the puna.

THE ALTIPLANO

The region under consideration is part of a high plateau rising from southern Peru, southwestern Bolivia, northeastern Chile, and northwestern Argentina. Visualize a terrain the size and shape of California, rimmed with 5,000 to 10,000-foot mountains, then raise this entire country 12,000 feet into the air and you will have some conception of the high plateau frequently referred to as the altiplano. It is the puna of some authors, but others have used puna to refer to some limited part of this high plateau, and still other authors in recent years have permitted the puna to escape from its geographical bounds to become a Life Zone, a large southern counterpart of the wetter Paramo Zone of Ecuador, Colombia, and Venezuela. Chapman (1921) and Osgood (1943) use puna in this last sense when they refer to it as the region above timber line and below snow line. As such a Life Zone the puna extends in Chile to the tip of Tierra del Fuego and near this southern end may occur as low as 1,000 feet.

Because the word puna has received so many different interpretations, I have found it preferable in this paper to use the more general term "altiplano" and define it as the treeless portion of southern Peru, Bolivia, northern Chile, and northern Argentina which can be reached from centrally located Lake Titicaca and Lake Poopo without going below 12,000 feet. Defined in this way the altiplano includes part of the Janca, Jalca, and Suni Zones of Vidal (1941), part of the Puna Zone of Chapman and of Osgood, and all of the puna of Weberbauer (in Macbride, 1936). No special significance hinges about the elevation of 12,000 feet; when more is known about the plants and animals of this region a more suitable bounding contour line might be designated. On some of the eastern slopes of the Andes, timber line extends above 12,000 feet. These forests are not considered part of the altiplano. A definition that is almost the equivalent of the above is to say that the altiplano is the home of the llama, alpaca, and vicuña. Other wide-ranging genera and species that may be considered indicators of the altiplano are a skunk (*Conepatus rex*), and the rodents *Chinchillula*, *Phyllotis boliviensis*, *P. sublimis*, and *Abrocoma cinerea*. *Punomys* and *Galenomys* are also endemic, but their ranges are so restricted that these rodents hardly serve as useful indicators. General descriptions of the altiplano may be found in Tschudi (1844, 1847), Bowman (1916), Schmidt (1945), Weberbauer (1945), and Hodge (1946).

The present report is based primarily on observations of that portion of the altiplano lying to the west of Lake Titicaca in southern Peru: a land of rolling grassy hills, flat pampas, rocky or sandy deserts, rugged peaks, volcanoes, and slopes of cinders and gravel. It is a land of low sage-like bushes called tola, tufts of grass, characteristic cushion-shaped plants, and, more often, bare earth. Trees such as imported eucalypti grow in towns and around ranch buildings, but only in one place have I seen trees away from habitations (*Polylepis* at Santa Rosa). The sparseness of the vegetation across this portion of the altiplano depends in part on the altitude or on concomitant factors such as temperature, and in part on the seasonal nature of the rainfall. Almost all of the precipitation falls during the Southern-Hemisphere spring and summer — as much as 38 inches of rain annually at Puno, 12,600 feet. At higher altitudes, as at Caccachara (16,000 feet), most of the precipitation is snow or hail. During our stay at the latter location there were occasional snow and hail storms in July, August, and September, more frequent ones in October, and between November 15 and December 11 some snow or hail fell every day.

Also characteristic of the altiplano is the temperature behavior. As in other mountainous regions the sun is remarkably bright and warming. Weberbauer (1945) reports that a thermometer with a blackened face when put in the sun registered 202° F., which is 15° above the boiling point of water at these altitudes. Even on sunny days, however, the wind is sometimes so cold and penetrating that shepherds huddle behind stone shelters or take refuge in trenches. At Hacienda Pairumani (13,000 feet) the temperature in the shade during a day in mid-July was as follows:

6:30 a.m. (sunrise)	14° F.
7:00 a.m.	22
8:00 a.m.	32
10:00 a.m.	49
12:00 noon	58
4:00 p.m. (cloudy since 2)	51
6:30 p.m.	44
7:30 p.m.	40

Sr. Eduardo de Amat, the owner of the Hacienda, told me that daily fluctuations from 58° to 3° F. are not uncommon during the dry season. During the summer wet season the nights at Hacienda Pairumani and over much of the altiplano are above freezing, but the days tend to be raw and cold because of cloudiness and rain. At altitudes higher than at Pairumani the daily temperature fluctuation is even greater and freezing may occur in every month.

TABLE 1

Average Temperature in °F. at Pasto Bueno, 13,000 Feet, February 22 to March 20. The air temperature was taken at 1.20 m. above the ground, soil temperature at a depth of 3 cm., and rock temperature in a small hole in the face of a rock exposed to the sun all day.

Data from Weberbauer (1945, p. 131)

	6 a.m.	*7 a.m.*	*8 a.m.*	*10 a.m.*	*noon*	*2 p.m.*	*4 p.m.*	*6 p.m.*	*9 p.m.*
Air	39	41	43	47	51	50	45	42	39
Soil	42	43	42	53	61	62	57	54	48
Rock	41	—	46	58	69	74	61	57	—

One never ceases to marvel at the hardiness of the plants that survive this combination of aridity, frequent freezing, and excessive daily temperature fluctuations during the dry season. Some plants are innately frost resistant, for it is not unusual to see them in full bloom with the temperature far below freezing. Many have developed a low, mat-forming growth habit which tends to retain moisture and avoid freezing. Indeed, *Distichia*, *Azorella*, *Pycnophyllum*, and *Oxychloe* have carried mat formation to such an extreme that a man can walk across the tightly packed leaves and stems of these flowering plants as across a pile carpet without crushing them. The advantage of prostrate habit to a plant living under the conditions of air, earth, and rock temperatures shown in table 1 are apparent. At an even higher elevation than that represented in table 1, as at Caccachara, and in the dry season, the earth and rocks at night are probably 5° or possibly 10° F. warmer than the air. The daily fluctuation of the temperature of earth or rock is greater than that of air, but it stays within a more favorable range for plants, thus benefiting those that hug these surfaces. Weberbauer (1945) stresses the fact that plants ascend to higher altitudes among cliffs and boulders than on bare ground. It should follow that the mammalian species living at the very highest altitudes are species at home among rocks and cliffs where they can make use of the vegetation, but knowledge of the habits of these mammals at their extreme upper limits is lacking.

A visitor may wonder how many animals a terrain as bleak as the altiplano supports. The number depends not only upon local conditions, but in my experience varies inversely with altitude. At Pairumani (13,000 feet) a line of 75 traps in July sometimes caught more than 25 mice in 24 hours, a catch greater than that usually obtained at a comparable season in the northeastern United States. A few weeks later at Caccachara (16,000 feet) a line of 90 traps caught at times no animals at all over a period of 24 hours and seldom caught more than a half-dozen daily. At an intermediate altitude, Santa Rosa, mice were about twice as abundant as at the higher location. Larger mammals, however, were fairly abundant at Caccachara. I have estimated that 780 viscachas lived within 3 miles of our camp (1 to each 25 acres). A herd of 7 to 12 vicuñas was almost always within a half-mile of camp, and three herds totalling 25 vicuñas spent most of their time less than a mile away. On one occasion from a single vantage point I counted with the aid of binoculars about 10 herds of vicuñas totalling 80 animals. My view covered approximately 15 square miles, which allows 120 acres to each vicuña. Vicuñas were probably as abundant here at Caccachara as anywhere, so these are near-maximum densities which should be compared with temperate zone populations such as one deer to each 25 acres on some of the best deer lands of the United States or one rabbit to each 2 acres over large areas in the eastern United States. These figures indicate that the altiplano is more productive than its barren appearance suggests.

It is my impression that the larger mammals at Caccachara outnumbered the smaller, an unusual relationship that may be typical of most of the remote, higher parts of the altiplano. There were 10 species of mammals at Caccachara smaller than a Norway rat, yet I do not believe that all the individuals of any one of these species would outnumber the viscachas, and it is possible that all the individuals of all these species added together would not outnumber the viscachas and vicuñas.

COLLECTING STATIONS

By reference to figures 1–10, to the articles cited, and to the text below it is hoped that the reader can gain some idea of the appearance, climate, and animal life of each location. A list of the mammals of each locality may be found in table 4.

Cailloma. Also spelled Caylloma. Department of Arequipa. Situated in a valley at the headwaters of Amazonian drainage at about 14,000 feet. Cailloma is a comparatively well-watered valley the climate of which has been outlined by Bowman (1916). Schmidt (1945) has also described the region and some of its animal life. We collected near Cailloma from November 30 to December 7, 1939, a season when morning sunshine and afternoon snowstorms can be expected.

Sibayo. Department of Arequipa. Situated at 11,500 feet on the Rio Colca, which drains into the Pacific Ocean. We camped along the road south of the town from December 8 to December 11, 1939. The vegetation was dominated by tola bushes 2 to 3 feet tall, with occasional grassy places along the streams. The hilltops were studded with rugged, rocky outcrops. Although Sibayo was clearly in the Mesothermal Tola Heath of Weberbauer (a plant association quite different than that at Cailloma) and slightly below the level of the altiplano, many of the mammals at Sibayo were the same as those at Cailloma 30 miles away over the continental divide.

Juli. Department of Puno, 12,500 feet, on the western shore of Lake Titicaca. We stayed at this town only a few days in December, 1939, and found the weather wet and cold. The outskirts of the town were divided by stone walls into terraced fields of potatoes, quinoa, and corn. There were occasional trees, grass-thatched stone huts, and numerous shrubs along the walls. Doves and flickers were abundant and guinea pigs (*Galea*) would scurry for the shelter of the stone walls at the approach of an observer. A few traps set along these walls caught *Andinomys* (a considerable northward extension of its range) and *Phyllotis darwinii* subsp.; *Akodon boliviensis* was caught in huts. Other kinds of mice undoubtedly live in the region. The inhabitants stated that grisons were abundant among the stone walls and that they preyed upon guinea pigs. Figure 9.

Hacienda Pairumani. Also spelled Payrumani. Department of Puno, 13,000 feet, about 22 miles southwest of Ilave on the Rio Huanque (Rio Blanco of some maps), which drains into Lake Titicaca. Collections were made here from December 21 to 26, 1939, and July 13 to 22, 1946. Figures 3, 4, 5, 14.

The valleys and hillsides at Pairumani are covered with grass and are grazed by sheep. Bare rock is exposed on some of the hilltops and there are occasional cliffs and rock slides. Small rodents were abundant during July in the grass, along stone walls, among boulders, and in houses. A line of 75 traps sometimes caught more than 25 mice in 24 hours. An interesting comparison is made in table 2 between the number and kinds of animals caught by us and by a colony of owls living in a cliff at Pairumani.

TABLE 2

PREY OF OWLS AT PAIRUMANI COMPARED WITH THE NUMBER AND KINDS OF MICE CAUGHT IN TRAPS

Based on 97 pellets collected on July 16 and September 21, 1946

	Traps	*Owls*
Akodon (Akodon) boliviensis boliviensis	61	26
Akodon (Bolomys) amoenus	22	3
Akodon (Bolomys) berlepschii	11	?
Akodon (Chroeomys) jelskii pulcherrimus	1	0
Hesperomys ducilla	3	50
Phyllotis (Phyllotis) darwinii subsp.	5	9
Phyllotis (Phyllotis) osilae subsp.	11	1
Phyllotis (Auliscomys) boliviensis flavidior	1	0
Phyllotis (Auliscomys) pictus[1]	24	<55
Phyllotis (Auliscomys) sublimis[1]	15	<55
Chinchillula sahamae	1	1
Neotomys ebriosus vulturnus	2	9
Cavia (Galea) musteloides	7	0

Santa Rosa. Department of Puno, 14,000 feet, on a branch of the Rio Huanque, 65 miles south of Puno. Figures 6, 7. Collections were made in a dry sandy area about 3 miles west of the town from July 22 to August 1, 1946. This spot was chosen because it was the only place where I have encountered numbers of trees growing wild at such a high altitude. For a few miles around Santa Rosa *Polylepis tomentella* grows to as much as 15 feet tall and 10 inches in diameter. Although there may be only a half-dozen of these trees to an acre, they are being cut and sold for firewood. The principal smaller plants were tola (*Lepidophyllum quadrangulare* and *Baccharis incarum*), thorn bush (*Margyricarpus strictus*), and grass clumps. The only mammal caught here that was not caught also at one or more of the other locations was the mouse *Eligmodontia.* This genus has not been reported before from Peru, but since it is apparently not arboreal, it is probably not dependent upon the presence of trees.

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[1] Could not be distinguished by means of the skull fragments in the pellets. Both together made up 54 of the 153 mammals eaten by the owls.

Caccachara. Caccachara is an uninhabited valley about 5 miles southwest of the crest of the western Cordillera (16° 41′ S and 70° 4′ W), approximately 50 miles southwest of Ilave. Camp was made at 16,000 feet on the floor of the valley at the foot of Cerro Ichuasi, a 17,300-foot peak which appears to be the core of an inactive volcano. See figures 1, 8, 10, and description and illustration in Pearson (1948). Past camp flowed a stream about 15 feet wide, the Rio Caccachara, on its way to the Pacific Ocean via the Rio Tambo. Its headwaters were a few miles to the north and east in various bowls immediately below the continental divide, which here is about 17,000 feet above sea level. We remained at Caccachara from December 27, 1939, to January 3, 1940, and from August 6 to December 13, 1946.

The first impression people from the eastern United States receive at Caccachara, even after days of travelling across treeless puna, is one of barrenness. One stands on the valley floor facing the apparently bare brown ridge of rocks, sand, and cinders that makes up the continental divide. A few yards to the left begins the western side of the valley — a slope of rock, minor knobs, and hills of bare sand or gravel of various hues from blue-black to lavender and yellow, steep gulleys, and scattered tufts of spiny grass (*Festuca orthophylla*), a few tola bushes only a foot or so tall (*Senecio adenophylloides*), and scattered pale yellow-green cushions of *Pycnophyllum.* To the right lies exposed the entire flank of Cerro Ichuasi, speckled with blue-grey tufts of spiny grass and a few tola bushes (fig. 1). The floor of the valley near the stream supports many clumps and mats of brown grass, but bare rock and earth are much more in evidence than vegetation. The only conspicuous patches of green, at least from July to January, are occasional heads of yareta (*Azorella yarita,* fig. 8) far up among the boulders and a few carpets of *Distichia muscoides* spilling down the slopes. The dominant plant over most of the region is the grass, *Festuca orthophylla,* which grows in pure stands of scattered clumps and crescents (fig. 10). Each culm is stiff, needle-sharp, and most of the stems in each clump are dry and lifeless. In the slightly damper flats along the stream, tufts of the grass *Festuca rigescens* and low mats of *Calamagrostis curvula* are dominant. A tola bush, probably *Lepi-*

dophyllum rigidum, a thorn bush about 1 foot high (*Senecio spinosus*), and cushions of *Pycnophyllum* are abundant on some slopes and terraces.

GEOGRAPHICAL RELATIONSHIPS OF THE MAMMALS OF THE ALTIPLANO

Most of the 25 mammalian genera and subgenera of the altiplano fall into one of the following two categories:

Found only on the altiplano: Chinchillula, Punomys, Neotomys, Galenomys, and *Vicugna*. Specimens of *Neotomys* have been taken in a few places at slightly less than 12,000 feet, but otherwise *Neotomys* is a good, wide-ranging indicator genus for the altiplano.

Found to the south and reaching their northern limit on the altiplano: Akodon (*Bolomys*), *Akodon* (*Chroeomys*), *Phyllotis* (*Auliscomys*), *Eligmodontia, Andinomys, Octodontomys, Cavia* (*Galea*), *Lagidium, Chinchilla, Ctenomys, Abrocoma, Chaetophractus*, and *Lama*. It is noteworthy that the South American hystricomorphs fall into this category rather than into the endemic group.

The ranges of some of the genera and subgenera listed above extend only a short distance south of the altiplano, while others of this group are found much farther south and at much lower altitude. *Andinomys, Bolomys*, and *Octodontomys*, for example, range widely over the altiplano and do not depart far from it at any place. *Chroeomys* is a common mouse from the northern to the southern end of the altiplano and in relatively few places drops below the 12,000-foot contour. On the other hand, *Lagidium, Galea, Ctenomys, Auliscomys*, and *Eligmodontia* range hundreds of miles from the altiplano and to much lower altitudes.

A few genera of the altiplano such as *Felis, Conepatus, Dusicyon, Akodon, Phyllotis* (*Phyllotis*), *Hesperomys*, and *Cavia* (*Cavia*) range widely to the north, south, and east, but it should be noted that aside from such wide-ranging forms the altiplano mammals have no close northern relatives.[1] In other words, the mammals of the altiplano are most closely related to more southern forms.

A somewhat similar situation prevails among the birds. Of 31 genera not given to extensive wandering and which live on the Peruvian altiplano, 7 are endemic and 19 are from the Temperate Zone to the south (Chapman, 1921). Among Chilean birds, Hellmayr (1932) points out that many species ranging widely in the Temperate Zone of central and southern Chile have representatives in the northern puna.

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[1] A possible exception is the weasel, *Mustela frenata* which may live on the altiplano near the southern end of its range. See page 169.

Many of the remarkable cushion-shaped plants of the higher parts of the altiplano, such as *Azorella, Distichia,* and *Pycnophyllum,* as well as numerous other less specialized plants of the region are highly endemic (Weberbauer, 1936). According to Smith and Johnston (1945) elements of the altiplano flora extend southward along the high Andes of Chile and Argentina to about central Chile where they meet the northern elements of the flora of the Patagonian steppe, and Macbride (1936) points out that to the north there is little mixing of the floras of Andean Ecuador and Peru. It appears, therefore, that the plants of the altiplano are to a great extent restricted to high altitudes, whereas many of the avian and mammalian genera have members living at low altitudes to the south.

In general the mammalian fauna of the altiplano is made up of numerous species but of few genera. Certain genera, notably *Akodon* and *Phyllotis,* have been able to overcome the difficulties of altiplano existence so successfully that in some places, as in the Santa Rosa-Pairumani region described above, five species of *Phyllotis* and five of *Akodon* are found together. A similar radiation of certain plant genera is characteristic of the flora of Caccachara where of 53 species (31 genera) of flowering plants other than grasses that were collected, 14 were Senecios, and there were more than four each of *Werneria* and *Descurainia.*

Hellmayr (1932) states that among Chilean birds one rarely finds members of any particular group in both the Puna Zone and Temperate Zone of the same latitude. A similar segregation is apparent among the mammals of southern Peru. Of the 25 genera and subgenera of the Peruvian altiplano, only *Akodon, Cavia,* and three carnivores (*Felis, Conepatus,* and *Grison*) descend well into the forests of the eastern slopes of Peru — or conversely, only *Akodon, Cavia,* and three carnivores from the east have been able to establish themselves on the altiplano. What keeps the animals in these two realms from invading each other's territory? Why have the lowland genera not evolved species capable of existing on the altiplano? Is it possible that the lowland genera cannot survive at great heights or that they have been unable to evolve species that are adapted physiologically for life at high altitudes?

PROBLEMS OF SURVIVAL ON THE ALTIPLANO

The only known modifications that can be considered strictly as adaptations to high altitude *per se* are certain properties of the blood of vicuñas, llamas, viscachas, rheas, and Bolivian geese (Hall, 1937). Cats and sheep have been shown to be unusually deficient in these blood properties, yet cats live at least as high as 13,500 feet and sheep even higher. It can be shown, furthermore, that many kinds of mammals living nearby are physiologically capable of surviving at high altitudes but do not live on the altiplano. Representatives of the rodent genera *Oryzomys, Thomasomys, Oxymycterus,* and *Microxus* abound in the forests of the eastern slopes of the Andes and make their way up the moist Urubamba Valley to as high as 13,000 or 14,000 feet, yet no member of these genera has really established itself out on the altiplano. Rabbits, which live in the forests to the east and tolerate altitudes higher than 14,000 feet in Ecuador, are similarly absent from the altiplano. The typically lowland order of marsupials has two genera, *Marmosa* and *Orolestes,* which have been captured on the eastern Andean slopes as high as 14,500 and 14,000 feet, respectively, yet with the exception of a single report of *Marmosa elegans* from near Lake Poopo (Thomas, 1902b) they have not been found out on the altiplano itself. Some factor or factors other than altitude bar them. One must conclude in the face of these facts that physiological adaptations for life at low oxygen tensions are not as important to the mammals of the altiplano as are the abilities to live in an open, dry habitat, to find adequate food among the sparse plant-life, and to survive and reproduce under the peculiar temperature conditions of the region.

Among the animals at Caccachara, a location where altiplano conditions are perhaps somewhat accentuated, all the mammals have thick, warm fur, especially *Chinchillula, Lagidium, Phyllotis sublimis,* and the vicuña. Many are unusually adept at thriving on the meagre, armed, and pungent vegetation of the region. Viscachas eat almost every plant that grows there including leaves, bark, and blossoms of the prickly thorn-bush (*Senecio spinosus*), needle-sharp spears of *Oxychloe andina* and *Festuca orthophyllum,* and bark and blossoms of rank-smelling Senecios and Wernerias. Vicuñas thrive here where other large herbivores fail. I have seen a herd of 24 vicuñas feeding on a desert that would not conceal a mouse and which I would not have thought could feed a rabbit.

Several of the altiplano mammals are protected against the cold by their diurnal habits. *Akodon amoenus* and *berlepschii, Phyllotis boliviensis, Punomys, Lagidium, Cavia,* and *Ctenomys* are diurnal and can retreat to their burrows at night when temperatures may drop as low as 0° F. The most difficult season for these diurnal animals is the summer (November to April) when at the higher altitudes it may hail, snow, or rain almost daily, usually in the afternoon. Consequently, diurnal animals must face melting snow and additional precipitation almost every day and they seem poorly equipped for life at this season. The fur of most of these animals wets easily; once wet the animal dies unless the sun is shining. From November 15 to December 11, 1946, it snowed or hailed every day at Caccachara. Wild viscachas lost weight during this time and it is not unlikely that if this weather had continued for another fortnight (as indeed it may have) many would have starved or died seeking food in the wet snow. Nocturnal mammals such as *Chinchillula, Phyllotis darwinii,* and *P. sublimis* must withstand extreme cold during the dry season, but they encounter better weather at night in the wet season than they would in the daytime. As far as is known none of the mammals avoids an unfavorable season by hibernating (for a possible exception see account of *Phyllotis sublimis*), and few store food (*Punomys* and possibly *Ctenomys*).

I find little evidence that Bergmann's and Allen's principles operate among the mammals that range from low to very high (hence cold) altitudes.

The animals of the altiplano are faced with the choice of bringing forth their young in the dry, clear, but cold weather from May to October, or in the relatively warm, wet season (November to April) when, despite snow at the higher elevations, plant growth is at its peak. The altiplano mammals at the places where I have studied them are in almost complete agreement in avoiding July and August as a season for either breeding or giving birth. Either it is biologically unprofitable to reproduce at this season, or else none of the animals have been able to break away from an inherited breeding pattern formed and fixed in another climate. At Caccachara every mammalian species except the vicuña breeds in September or October at the end of the dry season. The young of some mice are born before the wet season begins, but others are born in the middle of the wet season. Almost all the viscachas are born in the middle or near the end of the wet season. Young vicuñas are born in January or February and the females mate a short time afterward.

NOTES ON THE MAMMALS

There follows a list of the mammals of the altiplano of southern Peru, a key to the rodents of the highland area west of Lake Titicaca, and a few remarks on each form known to live on the altiplano of southern Peru. I have made no attempt to straighten out the confused taxonomic state of many of the genera. Appended is a list of neighboring mammals that might reasonably be expected to occur in this region.

The measurements, taken in mm., have been made by myself unless otherwise noted and are listed as follows: length (total length of the animal including tail); tail (the length of the tail); foot (length of the hind foot including the claw); ear (greatest height of ear measured from the notch). In dealing with long series the mean measurement is given, followed in parentheses by the maximum and minimum. Usually the measurements given are those of specimens from the location where the longest series was obtained or from the type locality.

Most of the trapping and field observation was carried out as a secondary interest to the study of the life history of the viscacha. Trap lines were set out as opportunity afforded and only a portion of the catch was preserved, although several examples of each species were prepared as specimens. All animals taken were measured and the condition of the reproductive organs was recorded. In the following accounts the measurements recorded are, unless noted otherwise, those of specimens actually preserved and now in the collection of the Museum of Comparative Zoölogy.

TABLE 4

A list of mammals of the altiplano of southern Peru. The number of specimens of each species caught by me and my associates at each of our major collecting locations is recorded in the columns, and these figures should give some idea of the relative abundance of the species at any one locality. The number of viscachas is disproportionately large because they were hunted more intensively. Specimens not preserved are included. An asterisk represents sight records, captures by other collectors, or other evidence of the presence of the species. Trapping was thorough enough at Pairumani, Santa Rosa, and Caccachara so that certainly most of the forms present were represented in our collection. More extensive collecting at the other locations might fill in some of the gaps.

	Juli *12,500 ft.*	*Pairumani* *13,000 ft.*	*Santa Rosa* *14,000 ft.*	*Caccachara* *16,000 ft.*	*Sibayo* *11,500 ft.*	*Cailloma* *13,500 ft.*	*Remarks*
1. Histiotus macrotus							Only at Yunguyo
2. Dusicyon culpaeus andinus		*	5	*			
3. Grison (Grisonella)	*						
4. Conepatus rex	*	*		*		*	
5. Felis concolor incarum				*			
6. Felis (Lynchailurus) colocolo garleppi							See p. 137
7. Akodon andinus lutescens			1	3		*	
8. Akodon (Akodon) boliviensis boliviensis	1	61	1		3	4	
9. Akodon (Bolomys) amoenus		22			3		
10. Akodon (Bolomys) berlepschii		11	16				
11. Akodon (Chroeomys) jelskii and subspecies		1	5	8	2	7	
12. Hesperomys ducilla		3	1	1			
13. Eligmodontia puerulus hirtipes			4				
14. Phyllotis (Phyllotis) darwinii subsp.	6	5	39	42	7	5	
15. Phyllotis (Phyllotis) osilae subsp.		11					
16. Phyllotis (Auliscomys) boliviensis flavidior		1		21		4	
17. Phyllotis (Auliscomys) pictus		24	2		3	4	
18. Phyllotis (Auliscomys) sublimis		15	4	35			
19. Chinchillula sahamae		1		6		4	
20. Punomys lemminus				8			
21. Neotomys ebriosus vulturnus		2	1	3			
22. Andinomys edax edax	3						
23. Cavia (Cavia) tschudii tschudii							La Raya Pass
24. Cavia (Galea) musteloides musteloides	3	7					
25. Lagidium peruanum		7	32	372		1	
26. Ctenomys opimus nigriceps				4			
27. Ctenomys peruanus							SW of Pairumani and at Pisacoma
28. Ctenomys leucodon							Near Huacullani
29. Abrocoma cinerea				5			
30. Hippocamelus antisiensis		3			3		
31. Lama guanicoe cacsilensis							Depts. of Arequipa, Cuzco, and Moquegua
32. Vicugna vicugna vicugna		*	*	*		*	

Key to the Rodents of the Altiplano West of Lake Titicaca

A.^{1} Color pattern strikingly chocolate and white....................11. *Akodon* (*Chroeomys*) *jelskii*
A.^{2} Color pattern not strikingly chocolate and white
B.^{1} Hairy cushion on soles of hind feet....................13. *Eligmodontia*
B.^{2} No hairy cushion on soles of hind feet
C.^{1} Tufts of comb-like bristles arising from the base of one or more toes of the hind feet
D.^{1} Tail 15 cm. or longer....................25. *Lagidium*
D.^{2} Tail less than 15 cm. long or absent
E.^{1} No tail
Lachrymal bone completely interrupts orbital branch of maxillary....................
24. *Cavia* (*Galea*) *musteloides*
Lachrymal bone not completely interrupting orbital branch of maxillary....................
23. *Cavia* (*Cavia*) *tschudii*
E.^{2} Tail more than 1 but less than 15 cm. long
Claws of front feet small, incisors very slender, soles granular....29. *Abrocoma cinerea*
Claws of front feet very long, incisors broad, soles not granular
Incisors pale....................28. *Ctenomys leucodon*
Incisors orange, fur pale (about buffy straw)....................27. *Ctenomys peruanus*
Incisors orange, fur dark brown and black....................26. *Ctenomys opimus*
C.^{2} No tufts of comb-like bristles arising from the base of one or more toes of the hind feet
G.^{1} Anterior face of upper incisors grooved
H.^{1} Groove near center of anterior face of upper incisors
Tail less than 50 mm. long....................18. *Phyllotis* (*Auliscomys*) *sublimis*
Tail 50 mm. or longer....................17. *Phyllotis* (*Auliscomys*) *pictus*
H.^{2} Groove close to lateral edge of upper incisors, snout red....................21. *Neotomys*
G.^{2} Anterior face of upper incisors not grooved
I.^{1} Ears small (less than 19 mm. measured from notch)
J.^{1} *Upperparts separated from white underparts by a bright line of buffy orange*
K.^{1} Total length less than 120 mm....................12. *Hesperomys*
K.^{2} Total length 120 mm. or longer
Tail sharply bicolored, grey above and white below....................
15. *Phyllotis* (*Phyllotis*) *osilae*
Tail not sharply bicolored, not white below..9. *Akodon* (*Bolomys*) *amoenus*
J.^{2} Upperparts not separated from underparts by a bright line of buffy orange
Color grey, no brown shades, belly white.......10. *Akodon* (*Bolomys*) *berlepschii*
Color olive brown or grey brown, pale patches behind ears, lips whitish..........
6. *Akodon* (*Akodon*) *andinus*
Color brown or yellowish brown, belly buffy or grey, no pale patches behind ears
8. *Akodon* (*Akodon*) *boliviensis*
I.^{2} Ears large (19 mm. or more measured from notch)
L.^{1} Head and body 130 mm. or longer, no orange, yellow, or bright buffy markings
M.^{1} Color over hips strikingly black and white....................19. *Chinchillula*
M.^{2} Color over hips not strikingly black and white
Tail half head and body or longer....................22. *Andinomys*
Tail less than half head and body....................20. *Punomys*
L.^{2} Head and body less than 130 mm., or if longer, with orange, yellow, or bright buffy markings
N.^{1} Ears 22 mm. or longer
Tuft of long buffy-yellow hairs in front of each ear; palms and soles blackish
16. *Phyllotis* (*Auliscomys*) *boliviensis flavidior*
No such tuft in front of each ear; palms and soles pale, no buffy streak on chest as in *P. osilae*............14. *Phyllotis* (*Phyllotis*) *darwinii* subsp.
N.^{2} Ears less than 22 mm., faint buffy streak on chest....................
15. *Phyllotis* (*Phyllotis*) *osilae* subsp.

1. HISTIOTUS MACROTUS (Poeppig) — Bat, Murcielago orejudo

Distribution. A rare species which according to Sanborn (1941) has been found only in southern and central Chile, southern Bolivia, and southern Peru.

Description. A medium-sized vespertilionid bat with very long ears connected by a low band of skin. Sanborn gives the following measurements: forearm, 47–51.5; ear from meatus, 31–37; height of tragus, 14–16.

Habits. Sanborn obtained two specimens of the above species at Yunguyo, 12,500 feet, Lake Titicaca, from natives who said they caught them in a house. I know of no other record of bats from the altiplano.

2. DUSICYON CULPAEUS ANDINUS (Thomas) — Fox, Wolf, Culpaeo, Zorro, Lare

Distribution. The genus ranges widely — from Ecuador to Tierra del Fuego. *D. c. andinus*, however, lives for the most part on the altiplano.

Description. A large, long-legged, reddish fox; the tail with a dark tip and a dark dorsal patch near the root. Measurements of two males from Santa Rosa are: length, 978, 1132; tail, 348, 389; foot, 160, 175; ear, 92, 101. The larger one weighed 20 pounds. Two females from the same region measured: length, 1024, 1053; tail, 345, 374; foot, 155, 155; ear, 100, 91; weight, 9.5 and 12.2 pounds.

Habits. Foxes were especially abundant around Santa Rosa and Caccachara. Tracks and droppings were seen everywhere in this region and five foxes were seen in one day while we were driving from Mazocruz to Caccachara. Some individuals were not particularly shy, for on several occasions they came within 30 yards of our tent and frequently dug up our discarded specimens of rodents. The stomach of one fox shot September 24 while he was sitting in the middle of a tuco-tuco and guinea pig colony contained three lizards and bird remains. Another shot amidst tuco-tuco diggings on the same day had eaten a mouse and part of a large, unidentified mammal. Droppings at Caccachara contained remains of birds, *Akodon*, *Phyllotis* (*Phyllotis*), *Phyllotis* (*Auliscomys*), *Lagidium*, and vicuña, but some of these may have been obtained as garbage or carrion from our dumps. Foxes were seen several times in the middle of viscacha colonies, once actually stalking a viscacha, but never did I find direct evidence of a viscacha having been caught by a fox. Sr. Mercenick, a mining engineer, told me that he had seen two vicuñas fighting. One knocked the other down and either seriously wounded or killed it, whereupon a fox that had been watching ran up, chased the victor away, and presumably ate the victim. Shepherds say that these foxes kill lambs.

Dusicyon was active both during the day and at night. By following tracks in the snow I concluded that they sometimes "hole up" under boulders or in rocky shelters during the middle of the day, and that they take refuge in such places when a snow or hail storm begins. One *Dusicyon* fled into an abandoned mine shaft when pursued.

I have never actually seen *Dusicyon* barking, but several bits of evidence lead me to believe that it makes owl-like hooting sounds which I described in my notes as follows: "a contralto booop"; "a rather deep, mellow boo-hoop"; "a honk-honk followed by a faint churr or flutter".

Untanned fox furs were for sale in Santa Rosa for one and a half soles each — the price of 4 pounds of rice. The hides of three specimens taken by me on September 24 were prime. The foxes seemed to be associating in pairs at this time. One female had a slender uterus and small ovaries, but another at this time, judging from the size of the vulva and uterus, and from the presence of large follicles in the ovaries, was near estrus. The granulosa of the large follicles was thrown into folds as has been described for the dog and silver fox. A male on September 24 had testes 24 mm. long, but one on July 24 had much smaller testes.

3. Grison (Grisonella) sp. — Grison, Hurón

Distribution. Grisons are widely distributed throughout South America and north into Central America.

Description. A mink-sized member of the weasel family, grizzled grey or buffy mixed with black on back and top of head, becoming black abruptly on underparts.

Habits. No grisons have been reported before from the altiplano of Peru. I have included it here on the basis of a single skin purchased in Juli, Department of Puno, in December, 1939. Inhabitants of this town assured me that grisons were abundant in the stone walls nearby, and that these animals preyed on the numerous guinea pigs. They were known to the natives in most of the regions where I collected, and many of them were familiar with the custom of keeping captive grisons like ferrets to drive chinchillas out of their burrows. I was told, however, that it was no longer legal to keep trained grisons.

4. CONEPATUS REX Thomas — Skunk, Zorrino

Distribution. Restricted to the altiplano of southern Peru, northern Chile, the Bolivian Plateau, and northern Argentina, probably up to 16,000 feet.

Description. A large black skunk with broad white areas on the back, the pattern different in different individuals. I have followed Osgood (1943) in considering several of Thomas's species from Peru and Bolivia as synonyms of *C. rex.* The measurements of the type of one of these (*C. arequipae* from Sumbay) are: length, 570; tail, 200; foot, 80; ear, 28. Colored picture in Cabrera and Yepes (1940, Plate 25).

Habits. Skunks are widespread over the altiplano but are seldom seen. We found a carcass at Cailloma and another along the road near Ilave, smelled the typical skunk discharge at Pairumani, and saw skunk-like tracks at Caccachara. Some animal at Caccachara, possibly a skunk, dug in the gravel under *Senecio adenophylloides*, the roots of which were covered with coccids.

5. FELIS CONCOLOR INCARUM Nelson and Goldman — Puma,
Mountain Lion, León

Distribution. In South America pumas extend from Panama to Patagonia, from sea level to 17,000 feet, but nowhere are they abundant. I have seen no skins from southern Peru where, according to Young and Goldman (1946), the local race should be *F. c. incarum*, a form that ranges south from southern Ecuador. Sanborn informs me that he saw a puma skin at Picotani, 16,000 feet, Department of Puno, said to have been taken near there sometime before 1941. On the altiplano it is rare and stays in the more remote hills.

Description. A large, long-tailed, dark, tawny, unspotted cat. It is said to be less rufous and longer-furred than *F. c. osgoodi* of Bolivia. The type, an adult male from the Department of Cuzco, measured: length, 1,905; tail, 685.

Habits. The puma is known to the natives west of Lake Titicaca but is seldom encountered. I followed puma tracks across a shoulder of Cerro Ichuasi at an altitude of about 17,000 feet, and at 16,000 feet found a mandible of a young puma in which the molar had not yet erupted. The latter find is interesting in view of the fact that domestic cats do not thrive at high altitudes, yet this young puma, many miles from low altitudes, probably was born above 13,000 feet. Pumas in this region probably kill some vicuñas and huemuls, and perhaps smaller prey such as viscachas.

6. FELIS (LYNCHAILURUS) COLOCOLO GARLEPPI — Matschie, Wild Cat, Gato Montes

Distribution. Cats of this species range from Patagonia to Ecuador, from low altitude to 16,000 feet. The subspecies *garleppi* has been reported from southern to north-central Peru.

Description. A small wild cat with irregular markings on the sides and back and with tail ringed by alternate light and dark markings. Pocock (1941) gives the following measurements of an adult female: length, 812; tail, 284; foot, 122; ear, 51.

Habits. I have never encountered this animal, but Sanborn informs me that he has collected three on the altiplano of southern Peru between 15,000 and 16,000 feet. One of these was hunting viscachas at night.

7. AKODON ANDINUS LUTESCENS J. A. Allen — Vole Mouse, Grass Mouse

Distribution. This is the most northern subspecies of the high-altitude *andinus* group, which ranges south through Chile to Mendoza (Argentina). The race *lutescens* has been reported from northern Chile to Cailloma, 13,500 to 16,000 feet (Osgood, 1944). I have followed Sanborn (in press) in considering *A. andinus polius* Osgood a synonym of *lutescens*.

Description. Similar to *Akodon boliviensis boliviensis* but smaller, general color paler, more olive; lips and chin almost white, pale patch behind each ear. Toothrow very short (about 3.5 mm.). Measurements of 2 males from Santa Rosa and Caccachara, respectively: length, 122, 122; tail, 49, 48; foot, 19, 18; ear, 13, 14. Two females from Caccachara: length, 130, 131; tail, 54, 51; foot, 19, 19; ear, 13, 13.

Habits. This little mouse is restricted to very high altitudes. It meets the more common *Akodon b. boliviensis* of somewhat lower altitudes at Santa Rosa (14,000 feet), Cailloma (14,000 feet), Sumbay (13,500 feet), Salinas (14,500 feet), and probably many other places at about this altitude. I caught it at Santa Rosa in a small rock pile surrounded by dwarfed thorn bush (*Margyricarpus*), tola, and grass clumps (fig. 7), where it was living in close association with *Phyllotis darwinii* subsp., *Phyllotis sublimis*, and *Hesperomys ducilla*. At Caccachara it was caught in rocky-grassy places.

Males on July 30 and December 1 appeared to be in breeding condition, but females on August 16 and September 8 contained no embryos.

8. AKODON BOLIVIENSIS BOLIVIENSIS Meyen —

Vole Mouse, Grass Mouse

Distribution. A common mouse of the altiplano of southern Peru. It has been reported (Thomas, 1920b) from as low as 3500 feet in the Urubamba Valley and meets the extremely high-altitude form *A. andinus lutescens* at the localities listed above.

Description. A short-eared, grizzled, brown mouse with the appearance of a meadow mouse (*Microtus*), but more slender. Underparts dull buffy gray. Face not buffy orange as in *Akodon amoenus*, underparts neither white, as in *A. berlepschii*, nor pale buffy as in *A. andinus polius*. Average measurements of 15 adults or young-adults from Pairumani are: 8 males — length, 156 (131–173); tail, 64 (53–69); foot, 20 (18–21); ear, 14 (12–15); and 7 females — length, 157 (136–173); tail, 66 (57–71); foot, 20 (19–21); ear, 13 (13–14).

Habits. A. boliviensis is a common mouse of grassy places such as that shown in figure 3 where its most common associates were *A. amoenus* and *Phyllotis pictus*. In rocky-grassy places such as shown in figure 5, it also is found with *P. darwinii, osilae*, and *sublimis, Chinchillula*, and *A. berlepschii*. Some *boliviensis* were caught in houses at Juli and Pairumani.

None of 29 females caught during July were pregnant, and only two of 27 males had testes longer than 6 mm. These two were probably capable of breeding. Several males caught in December had large testes of breeding size, and a female on December 22 contained 5 embryos. The ratio of sexes was 37 males to 30 females.

The following four species of *Akodon* (of three subgenera) live at Pairumani: *Akodon* (*Akodon*) *boliviensis boliviensis, A.* (*Bolomys*) *amoenus, A.* (*Bolomys*) *berlepschii*, and *A.* (*Chroeomys*) *jelskii pulcherrimus.* These four relatives, which do not differ greatly in size and proportions although their colors are quite different, are not effectively isolated from each other. *Boliviensis* and *amoenus* live side by side in the grass and the only ecological separation that we could discover (aside from the fact that *boliviensis* sometimes lives in houses) was a partial temporal separation: *amoenus* is largely diurnal whereas *boliviensis* is active both day and night. *Berlepschii* prefers the more open, barren hilltops, but it too is diurnal and its range partially overlaps that of its congener *amoenus*. *Jelskii pulcherrimus* shows a slight preference for rocky places but may be found anywhere. Like *boliviensis* it is active both day and night and lives at times in houses.

At Santa Rosa these four Akodons were found: *boliviensis boliviensis, andinus lutescens, berlepschii*, and *jelskii pulcherrimus*. *A. andinus* *lutescens* and *boliviensis* were effectively separated because *lutescens* was found only on hilltops in the barren habitat shown in figure 7, whereas the only *boliviensis* caught were in thicker grass along a stream at a few hundred feet lower elevation. *Berlepschii* at Santa Rosa lived among tola and bunch grass on sandy areas as well as among tola shrubs in rocky places. In the latter habitat it would meet *jelskii pulcherrimus* and probably *andinus lutescens*.

9. Akodon (Bolomys) amoenus Thomas

Distribution. Known only from southern Peru, where it has been caught as high as 14,000 feet on the altiplano and where it drops to 11,500 feet altitude west of the altiplano.

Description. A short-haired tawny mouse with long claws on the front feet. Face, arms, feet, and tail suffused with buffy orange, belly white. The average measurements of 7 adults from Pairumani are: 4 males — length, 161 (149–170); tail, 65 (62–69); foot, 20 (20–21); ear, 13 (12–13); and 3 females — length, 153, 151, 155; tail, 63, 63, 64; foot, 20, 19, 21; ear, 12, 11, 12.

Habits. This mouse is primarily an inhabitant of open grassy places (fig. 3) or tola and is diurnal. Owls at Pairumani had eaten only three *amoenus*. It lives alongside of its congeners, *A. berlepschii* and *A. boliviensis*, both of which are active during the day also. Males averaged slightly larger than females and were caught much more frequently than females (ratio 19:5). Males appeared to be coming into breeding condition toward the end of July when one specimen had testes as long as 10 mm., but none of the females were pregnant.

10. Akodon (Bolomys) berlepschii Thomas

Distribution. Described from Esperanza, near Mt. Sahama, Bolivia, *berlepschii* has not been reported before from Peru. This species and its close relative *A. albiventer* range widely across the altiplano from near Cailloma in southern Peru to Salta in northern Argentina. No *Bolomys* has been captured yet in Chile, although *berlepschii* might be expected to occur in the northeastern mountains.

Description. A comparatively short-haired mouse, back dark gray sprinkled with silver, underparts white; practically no brown or tawny shades. Ears paler than back, upper surfaces of feet almost white, contrasting strongly with the upper surface of the tail. Measurements of 3 adult specimens from Santa Rosa are: 2 males — length, 162, 172; tail, 69, 77; foot, 21, 22; ear, 13, 13; and one female — length, 167; tail, 77; foot, 22; ear, 13.

Habits. Although it was occasionally caught in the same traps that caught *A. amoenus, berlepschii* seems to prefer more shelter than the grass clumps that suffice for *amoenus.* At Pairumani *berlepschii* was trapped most frequently along the stone walls of a corral on a rather barren hilltop, and at Santa Rosa they were living in sandy places among tola shrubs. Besides *A. amoenus* its closest associates were *A. boliviensis, Phyllotis osilae* subsp., *P. darwinii* subsp., and *Chinchillula.* Trapping records indicate that it is mostly or entirely diurnal, and the fact that no *berlepschii* were represented among 153 mammals caught by owls at Pairumani is additional evidence of its diurnality.

Two males with testes 8 and 9 mm. long were caught on July 3 and 25, respectively, but 10 other large specimens caught at the same time were still sexually undeveloped. A female caught on July 30 had an open vagina and thick uterine horns, but no female contained embryos, so the breeding season must not begin until after July. The ratio of sexes was 17 males to 10 females.

11. AKODON (CHROEOMYS) JELSKII and subspecies—Ketacui

Distribution. This subgenus (and species according to the latest classification by Sanborn, 1947) ranges from central Peru through Bolivia to northwestern Argentina, but has not been reported from Chile. The altitudinal range is from 8,500 to 17,000 feet. The subspecies *pulcherrimus* is found only in southern Peru from the border of Lake Titicaca west to Cailloma and Sibayo, where it has been caught as low as 11,500 feet. It grades into *A. j. ochrotis* at the southern end of Lake Titicaca. *A. j. cruceri* also occurs on the altiplano of southern Peru somewhat to the north of the range of *pulcherrimus,* and *inornatus* probably lives on the altiplano also. The specimens listed in Table 4 and below all belong to the race of *pulcherrimus.*

Description. A strikingly colored mouse which cannot be confused with any other mammal of the region, chocolate-colored dorsally with white belly and white post-auricular patches. Measurements of six adult specimens from Cailloma are: 3 males — length, 165, 157, 173; tail, 73, 73, 74; foot, 23, 21, 25; ear, 18, 18, 19; and 3 females — length, 170, 161, 177; tail, 75, 72, 78; foot, 24, 23, 25; ear, 18, 18, 18.

Habits. A. jelskii occupies a variety of habitats such as grassy places, rocks, vacant huts, and even occupied houses. Its associates, therefore, may be almost any of the other mammals of the region. I have seen it as high as 17,000 feet. It is active both day and night. One individual that I encountered in the middle of the afternoon in a rock pile did not retreat at once but stamped its back feet nervously while watching me.

Two females and a male taken at Santa Rosa on July 29 were not in breeding condition, and four females taken during August and early October at Caccachara and one at Cailloma on December 2 contained no embryos. The uteri of most of the females were relatively thicker than those of other species of mice. Two males taken at Caccachara on October 5 and 13 had testes 6 and 7 mm. long, respectively, while others taken at this time or earlier had testes as small as 2.5 mm. The ratio of sexes was 8 males to 12 females.

Fleas, lice (*Hoplopleura affinis* n. ssp.), and mites (*Atricholaelaps glasgowi* (Ewing) were collected from *pulcherrimus* at Caccachara. This same kind of louse was found also on *Phyllotis darwinii* subsp. and *P. boliviensis flavidior,* while the same mite lived on *P. darwinii* subsp., *P. boliviensis flavidior,* and *Punomys.*

12. HESPEROMYS DUCILLA (Thomas) — Laucha

Distribution. H. ducilla has been reported heretofore only from the type locality San Antonio, near Lake Titicaca and is apparently restricted to the altiplano.

Description. A small, short-tailed mouse, buff above and white below, with a small white patch behind each ear. The color is similar to that of *Eligmodontia,* from which it may be distinguished by its shorter tail. It is a much smaller animal than the similarly short-tailed *Phyllotis sublimis.* Measurements of three specimens from Pairumani are: 1 male — length, 101; tail, 36; foot, 17; ear, 15; 2 females — length, 95, 97; tail, 32, 34; foot, 16, 16; ear, 13, 15.

Habits. Only seven of these little mice were caught, most of them at night in grassy places or in stone walls such as those surrounding corrals in open country. See figures 3 and 7. *Hesperomys* was apparently more abundant than this catch indicates, for the owls at Pairumani caught more *Hesperomys* than they did any other species. The nocturnal habits and grassland preferences of these mice make them natural owl prey, and it is possible that they are not attracted to trap baits (nuts were used for bait in most cases). *Phyllotis sublimis* was frequently trapped nearby.

A female on August 29 had an open vagina and thick uterine horns, but no female earlier than this contained embryos and none were caught later. Two males in July had testes 5.5 and 7 mm. long.

The only ticks encountered on any animal in the region were found on the ear of a *Hesperomys* from Pairumani.

13. ELIGMODONTIA PUERULUS HIRTIPES (Thomas) — Achucus

Distribution. No Eligmodontia has been captured before in Peru although the race *hirtipes* has been taken on the altiplano near Lake Poopo in Bolivia, and closely related forms live on the altiplano of Chile and Bolivia. I have followed the lead of Mann (1945) in considering *hirtipes* a subspecies of *puerulus.*

Description. A small, bright-buff mouse with pure white underparts; tail about same length as head and body. Easily recognized by the presence of a hairy cushion on the sole of each hind foot. Two adult males from Santa Rosa measured, respectively: length, 152, 158; tail, 78, 82; foot, 24, 24; ear, 15, 19; and two females from Santa Rosa — length, 153, 170; tail, 76, 85; foot, 24, 23; ear, 17, 17.

Habits. These four specimens were caught at night in a sandy area growing to tola (*Lepidophyllum quadrangulare* and *Baccharis incarum*) and scattered grass clumps a few yards from the habitat shown in figure 6. *Akodon berlepschii* was the most abundant neighbor. Mann (1945) states that the related *E. p. tarapacensis* is largely insectivorous, and Budin (in Thomas, 1919) stated that the race *jucunda* was caught on sandy soil and that it inhabited deserted tuco-tuco burrows. The structure of the hind foot of all these Eligmodontias suggests that they prefer sandy places.

The males on July 28 and August 1 did not appear to be in breeding condition (testes 4 and 5 mm. long). A female on July 31 had considerable mammary tissue but no embryos; another on August 1 was likewise not pregnant.

14. PHYLLOTIS (PHYLLOTIS) DARWINII subsp. — Pericote, Leaf-eared Mouse

Distribution. The various races of *P. darwinii* are not restricted to the altiplano but occur from central Peru through Bolivia, northern Argentina, northern and central Chile, and south, according to Osgood (1943), to Patagonia. In Peru they are found at sea level in the west up to 16,500 feet (above Caccachara), and as low as 9,100 feet in the Ocabamba Valley on the eastern side of the Andes (Thomas, 1920b).

Description. A long-tailed mouse, buffy grey lined with black above, white below without the buffy streak along the midline of the chest as in *P. osilae* subsp. Ears longer than in *osilae* subsp. *P. d. darwinii* is depicted in plate 38 of Cabrera and Yepes.

This common mouse is one of the *darwinii* group, shorter-tailed than *limatus*, less brown and shorter-tailed than *posticalis.* Juli, Pairumani, Santa Rosa, and Caccachara specimens are shorter-tailed than my specimens from Cailloma and Sibayo, and these in turn are shorter-tailed than *limatus*, the race to which Thomas (1912) assigned specimens from Cailloma, Arequipa, and La Paz. Because of the chaotic systematic state of the genus *Phyllotis*, I have not ventured to assign the present specimens to any subspecies.

Measurements of 3 adult males from Santa Rosa are: length, 217, 230, 194; tail, 120, 113, 97; foot, 26, 27, 26; ear, 25, 25, 23; and 10 females from Santa Rosa — length, 200 (175–232); tail, 103 (86–119); foot, 25 (23–27); ear, 23 (22–26). Measurements of the long-tailed form from Cailloma are: 5 males — length, 243 (235–251); tail, 127 (118–136); foot, 27 (26 28); ear, 25 (24–27); and 1 female — length, 225; tail, 120; foot, 26; ear, 26.

Habits. This is a mouse of rocky places. Boulders, rock slides, cliffs, small shale outcroppings, stone walls, and stone huts are all satisfactory habitations. In the region shown in figure 5 it was associated with *Chinchillula*, *Akodon berlepschii*, *A. boliviensis*, and *Phyllotis osilae* subsp. It shared the habitat shown in figure 7 with *Phyllotis sublimis*, *Hesperomys ducilla*, and *Akodon andinus*, although this could not be considered good terrain for *darwinii*. At Caccachara, its neighbors were *Lagidium*, *Abrocoma*, *Punomys*, *Chinchillula*, *Akodon jelskii*, and *Phyllotis boliviensis flavidior*, and at Santa Rosa it shared much of the suitable terrain with *A. berlepschii*. The latter was usually caught in the traps during the day, whereas *P. darwinii* subsp. was strictly nocturnal. All the specimens were caught at night, many of them in the first hour of darkness. Several wild-caught individuals had green vegetable pulp in their stomachs, but a caged specimen ate assorted grains and ignored the tola bush (*Senecio adenophylloides*) which his cagemate, a *Punomys*, relished.

Males and females at Pairumani were not in breeding condition from July 17 to 21, yet several males at Santa Rosa from July 23 to 25 had testes 9 or 10 mm. long. Pregnant females were caught at Santa Rosa on July 28 and August 1, but at Caccachara none were caught until October 5. Pregnant females and breeding males were caught frequently between this date and December 19, and immature specimens were caught on December 9. The average number of embryos was 4. In all 6 cases where the necessary data were recorded, there were more embryos in the right horn than in the left. The ratio of sexes was 64 males to 44 females.

Fleas, lice (*Hoplopleura affinis argentina* Werneck) and mites (*Atricholaelaps glasgowi* (Ewing), and a non-parasitic *Raphignathus* were collected from some individuals, and one specimen carried three new species of chiggers: *Euschöngastia phylloti* Wharton, *Trombicula biops* Wharton, and *Trombicula chara* Wharton.

15. PHYLLOTIS OSILAE subsp. — Pericote

Distribution. The species *osilae* is based upon two specimens described in 1901: one from Osila, 13,000 ft., and one from Tirapata, 13,000 ft. I obtained at Pairumani four specimens somewhat different from the typical form, which came from about 100 miles NNW of Pairumani, and Sanborn collected several specimens at Yunguyo, 12,500 ft., 44 miles west of Pairumani.

Description. A long-tailed mouse, buffy lined with black above, cheeks and sides buffy orange, chest with a median longitudinal streak of buff. It is shorter-tailed and not as rich a brown color as *osilae osilae.* Closely resembles *P. darwinii* subsp. but ears of *osilae* subsp. are smaller, vibrissae shorter and more slender, posterior palatal pits even with or posterior to the anterior margin of the interpterygoid fossa.

Three adult males from Pairumani measured, respectively: length, 200, 196, 197; tail, 102, 105, 107; foot, 25, 24, 25; ear, 20, 21, 21; and one female: length, 188; tail, 100; foot, 24; ear, 20. About eight others, probably of this subspecies, were caught at Pairumani and were discarded before it was realized that they differed from *darwinii.*

Habits. Phyllotis osilae subsp. was caught on grassy hillsides and on the grassy banks of gulleys at Pairumani. It differs, therefore, from the rock-loving *P. darwinii* subsp. which was also found at Pairumani but in fewer numbers. Both the rock-loving and grass-loving forms were caught at the base of the cliff shown in figure 5.

The original collector of *P. osilae osilae* stated that it was taken at the same localities as *P. boliviensis flavidior* and that it had the same habits. He shot one while it was feeding in the afternoon. Several of our specimens were captured at night. No pregnant females or breeding males were caught at Pairumani in July.

The owls at Pairumani had eaten only one of this form but nine of *darwinii.*

16. PHYLLOTIS (AULISCOMYS) BOLIVIENSIS FLAVIDIOR Thomas — Achohalla, Achulla, Pericote

Distribution. The subspecies *flavidior* has been reported from Cailloma and the highlands adjacent to Lake Titicaca in southern

Peru. *P. b. boliviensis* lives in northern Chile and on the Bolivian plateau. Most if not all specimens of both *boliviensis* and *flavidior* have been caught on the altiplano above 13,000 feet. *P. b. flavidior* lives even above 17,000 feet at Caccachara.

Description. A large mouse with tail slightly shorter than head and body; ears very large with a patch of yellow fur in front of each; palms and soles blackish. Average measurements of 12 adult specimens from Caccachara are: 8 males — length, 202 (182–215); tail, 85 (68–95); foot, 27 (26–30); ear, 26 (23–27); and 4 females — length, 193 (180–213); tail, 84 (76–90); foot, 26 (26–27); ear, 26 (24–27).

Habits. This mouse lives at high altitudes in many kinds of habitats such as rock slides, stone walls, and even in abandoned tuco-tuco burrows out in open country. Its food must also be varied, for twice it was seen feeding on lichens in rocky places, yet no lichens were available to those living in the tuco-tuco diggings. It is chiefly diurnal, a fact also noted by Bridges (1846) and Allen (1901). We saw many during the day, and a few were trapped at night. The owls at Pairumani caught none which confirms the evidence that these mice are chiefly diurnal. Because they live in so many kinds of places their animal associates include most of the species living at high altitudes. Most remarkable, however, is their close relationship with viscachas. I found them living in the midst of a colony of viscachas, and two of these *Auliscomys* habitually sunned on the rocks within a foot or two of sunbathing viscachas. When the viscachas moved down out of the rocks to feed, *Auliscomys* went along too and grazed like an elf among grownups. I have seen an *Auliscomys* that was feeding beside a viscacha scurry for shelter when a distant viscacha sounded the alarm whistle. The nearby viscacha in this case did not retreat. The nervous, droll movements of these *Auliscomys* are always entertaining, sometimes startling. Instead of peering cautiously out of tuco-tuco burrows they pop out: ears, head, and shoulders, with paws folded neatly on their breasts.

At Pairumani five species (of two subgenera) of *Phyllotis* were living side by side. All were about the same size although there were differences of color, tail lengths, ear lengths, etc. *Phyllotis darwinii* subsp. and *Auliscomys sublimis* were nocturnal whereas *A. boliviensis flavidior* was diurnal. *P. darwinii* restricted itself to rocky places, *osilae* and *pictus* preferred grass, but the others lived in both kinds of terrain. The relationship between the species is summarized in the table below where it is apparent that some isolation exists among the species, but that it is not complete. The habits of *osilae* and *pictus* are especially similar.

	Active at Night	*Active in Day*	*Grassy Habitat*	*Rocky Habitat*
darwinii subsp.	X			X
osilae subsp.	X	X	X	
pictus	X	X	X	
sublimis	X		X	X
boliviensis flavidior		X	X	X

A male at Pairumani on July 19 had small testes, several males at Caccachara had large testes (up to 10 mm. long) after September 15, and pregnant females were caught at Caccachara on October 7 and 23, and at Cailloma on December 6. The number of embryos varied from three to four. Juvenile individuals were seen on November 7 and 20. The ratio of sexes was 12 males to 12 females.

Fleas, lice (*Hoplopleura affinis*), mites (*Atricholaelaps glasgowi*) (Ewing), and chiggers (*Trombicula biops* Wharton, *T. chara* Wharton) were found on some individuals.

17. Phyllotis (Auliscomys) pictus (Thomas)

Distribution. From central to southern Peru; 11,000 to 15,000 feet. Part of the altiplano of southern Peru is populated also by the closely related or identical *P. decoloratus* Osgood.

Description. A stout, long-furred mouse; face grey, the color becoming more rufous over the shoulders and back; rump bright chestnut. Tail shorter than head and body. Anterior face of upper incisors grooved. Ears much smaller than in *P. boliviensis flavidior*, palms not dark as in *flavidior*. Average measurements of 9 adults from Pairumani are: 4 males — length, 223 (213–230); tail, 95 (90–100); foot, 25 (24–26); ear, 21 (20–22); and 5 females — length, 210 (200–230); tail, 85 (81–88); foot, 24 (23–26); ear, 20 (19–20).

Habits. A. pictus seems to prefer grassy places, especially those near water, but it also lives in stone walls and in places far from water. One was caught in an unoccupied Indian hut in which *Akodon jelskii pulcherrimus* was also living, but its usual associates are *Akodon boliviensis* and *A. amoenus.* It is active day and night. I was unable to distinguish between the skull fragments of *pictus* and *sublimis* in the Pairumani owl pellets, but these two species combined provided the owls with 54 of their 153 meals. By weight this would be the most important item in the diet of the owls.

None of 9 females caught between July 14 and 30 at Pairumani and Santa Rosa were pregnant, and none of 8 males had testes larger than 4 mm. A specimen in greyish juvenile pelage caught on December 22 suggests that breeding begins in September or October as in many of the other species of mice in the region. The ratio of sexes was 17 males to 16 females.

The ears of *pictus* are frequently nibbled away as the result of infestations of orange mites.

18. PHYLLOTIS (AULISCOMYS) SUBLIMIS Thomas

Distribution. Restricted to the altiplano where it has been reported from Cailloma, Peru, southeast to central Bolivia. A rather common mouse in this region from 13,000 to 18,000 feet.

Description. A short-tailed mouse with long, lax fur, ears comparatively small for a Phyllotis, feet and tail pale above; faint groove on anterior face of upper incisors. This is a much larger animal than the similarly short-tailed *Hesperomys* and has white underparts, rather than grey as in the short-tailed *Punomys*. Average measurements of 8 adults from Caccachara are: 5 males — length, 145 (128–158); tail, 48 (41–55); foot, 21 (20–22); ear, 20 (20–22); and 3 females — length, 140, 173, 156; tail, 44, 55, 45; foot, 22, 21, 21; ear, 20, 21, 22.

Habits. This is one of the commonest mice of the altiplano of southern Peru. It is nocturnal and seems to prefer the shelter of rocks in rather open, grassy places. A stone corral in a field of ichu grass is an ideal habitat, but *sublimis* will also live in abandoned tuco-tuco diggings, in rock piles, in stunted thorn and sage such as that shown in figure 7, or among boulders and yareta (figure 8). It shares these habitats with one or more of the following: *Phyllotis darwinii* subsp., *P. boliviensis flavidior, Hesperomys, Neotomys, Akodon jelskii pulcherrimus,* and *A. andinus lutescens.* Because it prefers grassy places it is more frequently found in valleys than on barren or rocky hilltops. It seems to be gregarious, for many times I have caught several at the same place, and Thomas (1900) reported that the type and 8 topotypes were all dug out of one burrow.

No external parasites were noted, but in three specimens from Pairumani on July 19 the liver was riddled with worms. Specimens with unprime skins were obtained in July, August, and September — the only months in which any *sublimis* were caught.

The most puzzling thing about these mice is their disappearance during October, November, and December. They were found in considerable numbers at Pairumani and Santa Rosa during July, and at Caccachara in August and early September. Thirty-four were trapped at Caccachara from August 16 to September 15. No more traps were set until October 4, whereupon considerable trapping in likely terrain was carried out until early December, yet not one more *sublimis* was caught during this time. Nor were any caught at Cailloma, Pairumani, and Caccachara in December of 1939. It seems likely that either the population was greatly reduced by disease in September in 1939 and 1946 (the wormy livers on July 19 may have been an augury) or that *sublimis* remains below ground, possibly hibernating, during much of October, November, December, and perhaps subsequent months. We saw no evidence of an epizootic nor of hibernation (except that one specimen was recorded as fat on July 15), but none of the later specimens were skinned, and therefore subcutaneous fat deposits may have been overlooked. Sanborn has kindly given me additional dates of capture of *sublimis*. These also suggest a disappearance during the wet season; his latest capture was October 7 and the earliest, April 30.

"Hibernation" during the southern hemisphere summer would not be totally unexpected in the case of *P. sublimis* because this mouse is nocturnal. Its unusually long, soft, thick fur would be good protection in the cold dry nights of winter, but might wet easily in the warmer nights of summer when the ground is frequently covered with wet snow. Such an escape (if it occurs) from wet and snow in summer is unique, and should, of course, be considered a form of estivation.

Males at Pairumani in mid-July had small testes (3 mm.), whereas those at Santa Rosa at the end of July were in breeding condition (testes 7 to 8 mm.). Males at Caccachara, however, did not reach breeding condition until September 3. None of the females contained embryos through September 15 when the last capture was made. It is interesting to speculate upon the time of reproduction if they estivate at the season when the other mice are reproducing. The ratio of sexes was 30 males to 21 females.

19. CHINCHILLULA SAHAMAE Thomas — Chinchillon

Distribution. Restricted to the altiplano of northern Argentina, northern Chile, Bolivia, north to Cailloma. Altitudinal range 13,000 to 16,000 feet.

Description. Most beautiful and silken-haired of all Andean rats. Strikingly marked, buffy lined with black over the back, ventrum white, hips and rump white with a conspicuous band of black. Tail shorter than head and body. Measurement of 6 adults from Caccachara are: 4 males — length, 265 (247–275); tail, 102 (97–109); foot, 33 (31–33); ear, 34 (33–36); and 2 females — length, 248, 251; tail, 95, 99; foot, 33, 32; ear, 34, 36.

Habits. Chinchillula is an animal of rocky places at high altitudes. It is most often caught among boulders and along stone walls. The surrounding vegetation may be grass, tola, yareta, or many of the other plants common in the region. At Pairumani, 13,000 feet, which is near the lower limit of the species, *Chinchillula* was trapped alongside of *Phyllotis darwinii* subsp., *Akodon boliviensis* and *berlepschii*, and *Lagidium* (fig. 5). At Caccachara its closest neighbors were *Lagidium, Punomys, Phyllotis darwinii* subsp., *P. boliviensis flavidior*, and *Akodon jelskii pulcherrimus*. It is nocturnal and herbivorous. At times its enormous stomach is distended by more than 12 grams of green, finely ground, vegetable matter.

Chinchillula is one of the rats known and distinguished by the natives, not so much because of its striking color pattern but because its exceedingly deep and fine fur makes it valuable commercially. The skins are used as trim or made into robes containing more than 150 skins. I never heard of a person who could be considered a professional *Chinchillula* trapper, but the skins were being sold by the natives at Santa Rosa and Juli for about 20 centavos apiece — the cost of a half-pound of rice. Mann (1945) states that Indians sell *Chinchillula* skins in the coastal towns of Chile, and he recommends that hunting be controlled to prevent extermination, as in the case of the Peruvian chinchilla.

No pregnant females were caught, although one on October 7 had an open vagina, thick vascular uterine horns, and prominent nipples. The testes of males are nearly spherical and reached a size of 6 or 7 mm. in diameter in October and November. Males and females were present in about equal numbers (5 males to 6 females), but nowhere were they abundant. The length of the head and body of males seems to be slightly greater than that of females.

Roundworms were found in the caecum of one specimen, and a small tapeworm in the intestine of the same individual. Many individuals harbored fleas, and some of these mice had in addition new species of mites (*Atricholaelaps chinchillulae* Strandtmann) and chiggers (*Euschongastia phylloti* Wharton). *Chinchillula* shares this chigger with *Phyllotis darwinii* subsp.

20. PUNOMYS LEMMINUS Osgood — Puna Mouse

Distribution. The genus has been known from a single specimen of *lemminus* from San Antonio de Esquilache, 16,000 feet. Additional specimens are reported below from Caccachara, about 40 miles south of the type locality.

Description. A stout, vole-like mouse, dull buffy-brown above becoming paler over the rump at the base of the tail; underparts pale grey. Tail quite short, palms and soles blackish. The Caccachara specimens agree with the type very closely in color, but all had longer tails than the type. The ears of my specimens measured fresh were considerably longer than the dry measurements recorded for the type. The only important skull difference lies in the lower incisor teeth, which in the Caccachara specimens are not separated by a gap. A considerable part of the gap in the type skull may result from the fact that the lower jaw has dried with the two rami much closer together posteriorly than in life. Since one zygomatic arch of the type skull is broken, I am listing the length and breadth of two of the Caccachara skulls with complete arches: greatest length, 32.7 and 33.9; zygomatic breadth, 18.2 and 19.4, respectively. Average measurements of 8 adults from Caccachara are: 4 males — length 200 (176–219); tail, 58 (48–69); foot, 28 (27–30) ear, 24 (22–25); and 4 females — length, 214 (201–224); tail, 63 (55–69); foot, 28 (27–30); ear, 24 (22–26).

Habits. Punomys escaped the attention of collectors until 1939 perhaps because it has such a restricted range, but strangely enough it was neither scarce nor shy at Caccachara. It was seen many times during the day, feeding or scurrying from the shelter of one rock to another. On three occasions specimens of *Punomys* took shelter among rocks without becoming greatly alarmed and allowed themselves to be captured by hand when the rocks were unpiled. When caged they showed no fear of people.

The food habits of *Punomys* are remarkable in several respects. They feed mostly or entirely on the two rankest smelling plants of the region: *Senecio adenophylloides*, a dwarf, fleshy-leaved tola shrub, and *Werneria digitata*, a low, ground-pine-like herb growing in moist places. They cut twigs of these plants in lengths of as much as 12 inches and store them under rocks, sometimes several dozen twigs in each cache. *Punomys* does not chew these plants thoroughly. Consequently, the stomach contains a pungent mass of coarsely chopped plant material, and the large, irregularly shaped feces contain larger fragments of undigested vegetation than do the pellets of other rodents. These droppings remind one of large shrew scats.

The favorite food of captives was the blossoms of *Senecio adenophylloides*, but the leaves and bark were eaten as well. One captive manipulating a 6-inch sprig of *Senecio* dextrously with its front paws nibbled along the stem corn-on-the-cob fashion, eating the flowers and leaves, then shifted back to the beginning and nibbled down it again in the same direction stripping and eating the bark. Captives also ate *Werneria digitata*, but refused two other kinds of *Senecio* closely similar in appearance to the species that they did like. One captive learned to pick rolled oats out of a mixture also containing wheat, barley, and quinoa. None of the wild *Punomys* seemed to be attracted by a variety of baits, and the only ones caught in traps probably stepped in them without having been lured by bait.

Punomys was always encountered among rocks near yareta and the two food plants mentioned above, and not far from water. It was seen during the day but not at night. Its closest associates were *Lagidium*, *Phyllotis boliviensis flavidior* and *P. darwinii* subsp., *Chinchillula*, and *Akodon jelskii pulcherrimus*. Its known altitudinal range (16,000 to 17,000 feet) is higher than that of any other mammal. Several others go as high, but they are not restricted to such a high level.

Males captured August 11, September 10, October 7, and October 11 had testes 9 to 11 mm. long. Females on September 10 and 13 and on October 4 contained no embryos, but one caught on November 7 had a 23-mm. fetus in each horn of the uterus. Each ovary contained an extremely large, red corpus luteum, and microscopic sections revealed in addition a smaller, apparently functional corpus luteum in each ovary. No juvenile individuals were encountered. Dark unprime patches were found on the pelts of the August and September specimens. The ratio of sexes was 4 males to 4 females.

Fleas, mites (*Atricholaelaps glasgowi* (Ewing), and chiggers (*Trombicula pearsoni* Wharton) were found on some of the specimens.

21. NEOTOMYS EBRIOSUS VULTURNUS Thomas — Red-nosed Mouse, Marsh Rat

Distribution. *Neotomys* is almost restricted to the altiplano. It is represented by the subspecies *N. e. vulturnus*, which ranges from northwestern Argentina to southern Peru on the west side of Lake Titicaca, and by *e. ebriosus*, which ranges from central Peru into Bolivia on the eastern side of Lake Titicaca. The known altitudinal range is between 11,000 and 16,000 feet.

Description. A mouse, grey-brown on the back, conspicuously lined with black, easily identified by its bright rufous nose, unusually long guard hairs, and broad incisors grooved near the outer edge. A male from Caccachara measured: length, 181; tail, 71; foot, 24; ear, 17; and a female from the same place (measured by Anita Pearson) — length, 177; tail, 70; foot, 25; ear, 17.

Habits. All of these specimens were caught in grassy places, and most were near streams. They were active both during the day and at night. Males on July 15 and 21 had small testes (4 and 5 mm.), while those on July 28, August 13, and September 1 had testes 8 mm. long. A female on August 13 carried no embryos. The ratio of sexes was 5 males to 1 female.

22. ANDINOMYS EDAX EDAX Thomas — Chozchorito

Distribution. The genus is found between 5,600 and 16,000 feet in northwestern Argentina, Bolivia, and it is here reported for the first time from Peru. The southern part of the range (Catamarca and Tucuman) is occupied by *A. e. lineicaudatus* Yepes.

Description. A stout, rat-like form, uniformly dark buffy above and grey below, tail slightly shorter than head and body but much longer than that of the otherwise similar *Punomys.* Measurements of three adult females taken December 18, 1939, at Juli are: length, 265, 258, 267; tail, 115, 118, 119; foot, 28, 28, 28; ear, 23, 22, 24. Depicted in Plate 40 of Cabrera and Yepes (1940).

Habits. Eleven traps set on the ground in the late afternoon among stone walls, shrubs, and trees a few yards from Lake Titicaca at Juli held three *Phyllotis darwinii* subsp. and the above three *Andinomys* in the morning. Two of the *Andinomys* were in meat-baited Schuyler traps, and the third was baited with corn meal. One of the females contained three large embryos (about 34 mm. Crown-Rump).

In various articles Oldfield Thomas has published the following collectors' notes regarding *edax edax:*

1919 "... caught among the rocks on the banks of a stream." (Budin)

1913 "Lives in the branches of trees, where it makes its nest." (Budin)

1902 "Caught in thicket of oak-like bushes; nocturnal." (Simons)

and regarding *edax lineicaudatus:*

1926 "Lives in round holes, quite clean, and the inside is carpeted with very fine straw; feeds on green herbs." (Budin)

23. CAVIA (CAVIA) TSCHUDII TSCHUDII Fitzinger — Guinea Pig, Cavy, Cuis, Cuiso, Conejo

Distribution. The species ranges widely in Peru, and a single subspecies has been described from northwestern Argentina, but none from Bolivia or Chile. The subspecies *tschudii* has been reported from low altitudes near the coast of south-central Peru up to 14,000 feet at La Raya Pass on the border between the Departments of Cuzco and Puno.

Description. Similar externally to *C.* (*Galea*) *musteloides,* from which it may be distinguished by the fact that the orbital branch of the maxillary in the subgenus *Cavia* is continuous (not broadly interrupted by the lacrimals). Also, the incisor teeth are said to be less pigmented in typical *Cavia*.

Habits. I obtained no guinea pigs of the subgenus *Cavia*.

24. CAVIA (GALEA) MUSTELOIDES MUSTELOIDES Meyen —

Guinea Pig, Cavy, Cuis, Cuiso, Conejo

Distribution. *C. musteloides* or its subspecies live in the mountains from southern Peru to northwestern Patagonia, and one race has been reported from sea level in eastern Argentina. In Peru I have not seen guinea pigs above 14,000 feet, but Thomas (1926b) has reported them from almost 15,000 feet in southern Bolivia.

Description. A rat-sized, thin-furred rodent with short ears and no tail. This and the preceding guinea pig are the only tailless mammals of the region. Measurements of three males from Juli are: length, 240, 235, 210; foot, 36, 38, 37; ear, 22, 23, 21.

Habits. Guinea pigs are one of the most frequently seen mammals of the region, for they often make their burrows in ditches, stone walls, or culverts along the roads. Many have their dens out on the open plains where they are apt to be closely associated with *Ctenomys peruanus* or *C. leucodon*. Indeed, they may frequently live in tunnels dug by the tuco-tucos. *Ctenomys* in return probably benefits from this relationship, for the more-abundant, bolder, and less fossorial guinea pigs must satiate many predators that would otherwise stalk the tuco-tuco. The diurnal habits of these guinea pigs, their abundance, and their short-legged gait as they scurry for shelter along the roads reminds one of Belding ground squirrels. I cannot account for the statement by Allen and Garman (1875) that Galea is nocturnal, for the ones I observed always retired about sunset and did not reappear until well after dawn. They stayed above ground later, however, than their associates, *Ctenomys peruanus*. The fact that there were no guinea pigs in the owl pellets at Pairumani is further evidence that they are diurnal. Of twelve animals represented in pellets (probably hawk) picked up under telegraph poles between Pairumani and Santa Rosa, five were *Galea*. Natives assured me that grisons and foxes also captured great numbers of guinea pigs.

None of three females collected July 20 to 22 was pregnant, nor were three males at this time in breeding condition; the largest testes were 8 mm. long. On September 23 none of 6 females contained macroscopically visible embryos, but the testes and seminal vesicles of three males had begun to enlarge. The testes of one had reached a length of 16 mm. On December 13 four males had testes from 16 to

20 mm. long, and all of the 12 females captured were pregnant. Embryos ranged from microscopic in size to one with head and body 91 mm. long. The number of embryos was 1, 2, or 4, with a mean of 2.0. There were 16 corpora lutea in the right ovaries and 14 in the left, with 14 embryos in the right uterine horn and only 10 in the left. Three of the embryos were being resorbed. Prenatal mortality, therefore, is fairly high, for thirty ovulations resulted in only 21 healthy fetuses, with the probability that more would perish before parturition. There was no evidence indicating transmigration of ova into the opposite horn of the uterus. Since no nonbreeding males or females were encountered in December, it seems probable that they breed in their first year. The ratio of sexes of adults was 14 males to 21 females; that of large fetuses, 4 males to 6 females.

25. LAGIDIUM PERUANUM Meyen — Mountain Viscacha

Distribution. Mountain viscachas range from southern Chile to central Peru, always in rocky places above timberline. In Peru they live almost entirely on the altiplano. Several species have been described from Peru, but most of these are probably subspecies of or identical to *L. peruanum.*

Description. A very soft-furred, grey rodent with the size and general appearance of a rabbit, but with a conspicuous, upward-curling, long tail. The fur is somewhat similar to that of chinchillas, but *Lagidium* is a larger animal with much longer ears and tail. Measurements of 288 adults from Caccachara are as follows: 144 males — length, 611 (561-665); tail, 269 (239-320); foot, 92 (85-102); ear, 64 (57-72); and 144 females — length, 613 (549-675); tail, 269 (231-304); foot, 93 (84-99); ear, 64 (56 74). Excellent color plates of related species in Bennett (1835) and Cabrera and Yepes, Plate 44.

Habits. Diurnal, herbivorous, and gregarious. They emit a thin, high-pitched whistle as a danger signal. The breeding season begins late in October, and only one young is born at a time. An account of the life history of this viscacha has appeared elsewhere (Pearson, 1948).

26. CTENOMYS OPIMUS NIGRICEPS Thomas — Tuco-tuco, Tacorro, Tocoro, Conejo del Cerro

Distribution. This northernmost subspecies of *Ctenomys* is found at very high altitudes in southern Peru. The other two subspecies of *opimus* are found only on the altiplano of nearby Bolivia and northern Chile, and in the mountains of northwestern Argentina.

Description. A very dark gopher-like animal with black markings on face and head; short-tailed with long claws on front feet and no ear pinnae. Anterior face of upper incisors broad and orange. It may be distinguished from *C. peruanus* by its darker color and from *leucodon* by its deeply pigmented incisors. It is a very stocky animal (one female weighed about .7 pounds) and one of the few mammals of the Caccachara region that become fat. Average measurements of four females from Caccachara: length, 271 (252–293); tail, 85 (80–95); foot, 37 (35–39); ear, 7 (7–8). Color plates of related species in Cabrera and Yepes, Plate 45.

Habits. This dark tuco-tuco is a very important animal in the high country around Caccachara, although it is seldom seen. It is more reluctant to show itself above ground than is *C. peruanus*, does not live in as large groups, and does not call attention to itself by "bubbling", as does *peruanus*. It reveals its presence by stripping large areas of hillside of the natural growth of spiny grass, *Festuca orthophylla*, and by small piles of dirt at the entrances to its burrows. The entrances of used burrows may be open or may be filled with dirt. Usually the area occupied by these tuco-tucos is nearly or completely denuded and may be 100 feet or more across. On some favorable hillsides, such as east-facing slopes of the Caccachara Valley, I have estimated that the vegetation of one tenth to one quarter of the entire slope has been completely destroyed by *nigriceps*, leaving the hillside a patchwork of completely bare and of untouched areas. It is my impression that only one pair of tuco-tucos occupies each of these bare patches. I have seen as many as five *nigriceps* in one morning, but this is surprisingly few considering how many diggings there are. Tuco-tucos were usually seen during the bright hours of the morning, never at night.

When the Ctenomys leave or are removed from one of these bare patches, grasses other than the original *Festuca* may spring up, and lizards (*Liolaemus multiformis*) and mice (*Phyllotis sublimis* and *boliviensis flavidior*) frequently make use of the burrows. It is not impossible that these other animals are found even in occupied burrows, for I have shot *Phyllotis boliviensis flavidior* emerging from a tuco-tuco burrow that may well have connected with a series of tunnels which a *Ctenomys* was digging only 10 yards away. Herds of vicuñas also use the *Ctenomys*-bared areas for dusting.

One tunnel in light sandy soil was dug out with a shovel for a distance of about 30 feet. Nowhere did this tunnel go more than a foot below the surface except at the grass-lined nest which was about a foot and a half below the surface. A chamber just outside the nest was filled with cut blades of grass, as were two other small chambers situated under grass clumps. A few short blind passages left the main tunnel, but there were few long branches. Numerous droppings were found in the nest and in the food chambers.

On one occasion I saw a tuco-tuco working at the entrance to its tunnel. It emerged head first, turned around and disappeared into the tunnel where presumably it loosened the dirt with its front paws. Then it swept out the diggings with simultaneous flips of both back feet causing the dirt to spurt 6 inches into the air. Two or three times a minute it stopped digging to watch me, with only the top of its head visible above the ground. Finally, when I had crept up to about 10 yards from it, it became frightened, dived into its burrow, and did not reappear. On many other occasions frightened *nigriceps* failed to reappear, whereas specimens of *peruanus* will frequently poke their heads out of distant holes to watch. One *nigriceps* became frightened when it was about two lengths out of its burrow and rapidly ran backwards into its hole.

Tunneling is facilitated by long strong claws on the front feet and by a fringe of hairs around the borders of the back feet, which are used to sweep the dirt out of the tunnels. In addition to the well-known fossorial adaptations of short tail and absence of ear pinnae, the manner in which the eyes are set almost on a level with the flat top of the head might be considered an adaptation for underground life, for it enables the tuco-tuco to see about above ground without raising its head far above the surface. The fact that tuco-tucos spend little time above ground and do not venture more than a few feet from their burrows does not protect them entirely from predation, for they were present in hawk pellets. On one occasion I saw a fox sitting patiently in the middle of some diggings probably made by this species of tuco-tuco.

Females on August 26 and 29 were not visibly pregnant, but two females on September 29 and 30 were pregnant. One of these pregnant females had two swellings each 18 mm. in diameter in the right uterine horn. Each swelling contained a 2-mm. embryo and there were two corpora lutea in the right ovary. The other pregnant female contained two 33-mm. embryos in the left horn of the uterus and in the right horn was a much smaller, irregular swelling in which no embryo could be detected. It had probably been resorbed. There was one corpus luteum in the right ovary and two in the left.

Fleas and lice (*Phtheiropoios* sp.) were collected from one individual.

27. Ctenomys peruanus Sanborn and Pearson — Tuco-tuco, Tacorro

Distribution. This species has been found only at high altitude in a small area of the altiplano of southern Peru where its range meets and probably overlaps with that of *C. opimus nigriceps* (Sanborn and Pearson, 1947).

Description. General appearance similar to *C. opimus* but color paler (creamy-buff), dark around ears and lips, anterior face of incisors orange. Measurements of 3 females from the pampas between Hacienda Pairumani and Mazocruz (on the Ilave-Tacna road), 13,500 feet, are: length, 277, 288, 271; tail, 76, 73, 68; foot, 36, 39, 34; ear, 8, 8, 8.

Habits. This tuco-tuco seems to be an animal of open pampas, whereas *C. opimus nigriceps* is more often found in hilly country. The two species meet between Santa Rosa and Mazocruz. Thousands of *C. peruanus* live at about 13,500 feet in much-grazed pampa of thorn bushes (probably *Margyricarpus*) less than a foot high, closely cropped grass, dwarf flowers, and occasional tufts of taller grass. The tuco-tucos usually avoid the patches of thorn bushes, but in the sandy and gravelly soil in adjacent parts of the pampas they are so abundant that they must compete seriously with the alpacas, llamas, and sheep that graze on these plains. One patch of gravel and pebbles about 50 yards across must have had a dozen tuco-tucos living in it, not to mention a number of guinea pigs (*Cavia m. musteloides*). Both Sanborn and I noticed the close association between these two genera and have concluded that the guinea pigs take advantage of the superior digging ability of the tuco-tucos. Perhaps they benefit as well from the curious alarm call of the tuco-tucos, which is a musical bubbling not unlike the song of a bobolink. When a person walks across a region inhabited by *C. peruanus*, this sound seems to come bubbling up out of the ground. Such a call has been described for other tuco-tucos and gave rise to their common name. Their presence is frequently betrayed by this sound as well as by the presence of numerous entrances to burrows. The hunter soon learns to look for the motionless profile of a head at the entrance to these tunnels.

These tuco-tucos are active during the day and disappear in the late afternoon before the guinea pigs have retired and long before dusk. One cloudy, raw, and windy morning neither the tuco-tucos nor the guinea pigs appeared until several hours after dawn. The stomachs of several specimens contained only coarse vegetable matter.

None of three females shot on September 23 was pregnant, and a male on the same date had testes 12 mm. long. On December 13 three males had testes 15 to 21 mm. long, and one of two females was pregnant. The swellings in the uterus (3 in the right and 2 in the left) were about 10 mm. wide, but as in several other hystricomorphs, the embryo at this stage had not grown enough to be visible macroscopically. The ratio of sexes was 4 males to 5 females.

Fleas were collected from one specimen.

28. CTENOMYS LEUCODON Waterhouse — Tuco-tuco, Tacorro

Distribution. Described from the Department of La Paz, Bolivia, this species has only recently been reported from southern Peru near Huacullani, 13,000 feet (Sanborn and Pearson, 1947), and is thus restricted to the altiplano.

Description. General appearance gopher-like, similar to *C. opimus* but distinguishable from the other tuco-tucos of Peru by the pale anterior surface of its incisors. Sanborn and Pearson (1947) give the following measurements for three females from Huacullani: length, 265–278; tail, 68–78; foot, 35.

Habits. I have never encountered this animal, but Sanborn found it near the southern end of Lake Titicaca living in close association with *Cavia musteloides musteloides.*

29. ABROCOMA CINEREA Thomas — Chinchilla Rat, Chinchillón

Distribution. This species has been found only on the altiplano in Argentina, Bolivia, and Chile, and is here reported for the first time from Peru. The known altitudinal range is from 12,200 to 16,000 feet. The genus is also represented in southern Peru by *A. oblativa* Eaton, skulls of which have been found in Indian graves at Macchu Picchu to the east of the altiplano.

Description. A large, silver-grey, short-tailed rat which may be recognized by the granular soles of its feet, by its delicate incisors, and (in life) its large, disc-like ears. It has, in common with many other hystricoids, combs of stiff curved bristles arising at the base of the claws of the hind feet. In *cinerea* these combs are found on all except the outer toe and are probably used to evict parasites and help to keep the fine fur untangled. Three adult females of *A. cinerea* from Caccachara measured, respectively: length, 225, 256, 237; tail, 59, 74, 68; foot, 26, 28.5, 27; ear, 23, 25, 23. The size of the foot of these specimens indicates that Budin's original field measurements of the type were probably correct (see Thomas, 1920a). Depicted in Plate 42 of Cabrera and Yepes.

Habits. Abrocomas were encountered only in one place, where six or more lived within 20 yards of each other in holes in the ground like those of Norway rats. These burrows were all at the edge of an outcropping of shale and some opened under tola bushes. The most important plants nearby were the yellow-flowered tola (probably *Lepidophyllum rigidum*) and another tola, *Senecio adenophylloides*. At least one of these was being used for food by the *Abrocoma*. Specimens of *Phyllotis darwinii* subsp. were caught a few yards away. *Abrocoma* could not be induced to take bait, and the best results were obtained by setting unbaited steel traps. The scats are slightly smaller and more pointed than those of a Norway rat. A female caught in a trap by one front leg emitted a faint bubbling sound reminiscent of that made by tuco-tucos.

The ovaries and uteri of an adult female captured on October 11 were quite large, but she contained no embryos and the vagina was not open. Another female on December 5 contained one small swelling in each uterine horn, the vagina was open, and milk could be expressed from the nipples. One pair of nipples was axillary, and the other pair was situated rather laterally on the abdomen. Microscopic sections revealed three large, exceedingly vascular corpora lutea in one ovary, and one in the other. A female captured on December 6 was carrying a 45-mm. fetus in each uterus, the vagina was open, but she was not lactating. It is probable that one of these pregnant females was the mother of two young Abrocomas caught at this time at the same place. The total lengths of the young were 170 and 182 mm. Mann (1945) mentions a female *cinerea* caught in northern Chile in April accompanied by two young about a week old.

Several specimens of *A. cinerea* had fleas, and one supported in addition two new species of lice (*Gyropus pearsoni* Werneck and *Neohaematopinus* sp.).

30. Hippocamelus antisiensis (d'Orbigny) — Huemul, Guemal, Taruga

Distribution. Huemuls are found in small numbers in the high mountains of Ecuador, Peru, Bolivia, and northern Chile up to 16,500 feet. In Peru their home is usually a little below that of the vicuñas and is sometimes below the level of the altiplano. Another species, *H. bisulcus*, ranges far to the south in Chile.

Description. A deer about the size of a vicuña but with shorter legs and neck, the males with two-pronged antlers, at least in December and July. The antlers of December specimens were densely furred, but I have not examined July specimens. The color of skins taken in December is for the most part a creamy buff with dark brown markings on the face and dorsally at the root of the tail. The ventral surface of the tail is white and the rump is conspicuously white. Huemuls seen in July but not collected appeared more grey than creamy buff and were recorded as having very dark bellies. While running, huemuls remind one of pronghorn antelopes, probably because of their gait and the white ruff on the rump. The brittle, pithy, wavy hairs make the hides feel much like those of pronghorns also. Measurements of five specimens collected in December at Sibayo and Pairumani are: 3 males — length, 1460, 1390, 1380; tail, 130, 125, —; foot, 365, 345, —; ear, 165, 150, —; height at shoulder, —, 770, 750; greatest length of antlers measured on outside of curve from burr, 270, 220, 250; and 2 females — length, 1280, 1300; tail, 110, 120; foot, 320, 340; ear, 140, 150; height at shoulder, 690, 710.

Habits. At Sibayo and Pairumani huemuls were living among grassy hills studded with rugged rock outcroppings and natural caves, 11,500 to 14,000 feet. They were not as unwary as has been described for *H. bisulcus*. I found them associating in groups of two to eight in July and December. A buck and doe were found grazing together during the morning of December 11, 1939, and several bucks and does were in one herd in July, 1946. Two females shot on December 23, 1939, were pregnant: the fetus in one of them was 410 mm. long including the tail, and judging from this size it is not unlikely that it would have been born in February or March. This suggests that a young male shot on December 11 with short spike horns and lacking the last molars was about 8 months old.

We found the meat quite good to eat, but many upper-class Peruvians regarded it much as North Americans do goat meat.

31. LAMA GUANICOE CACSILENSIS (Lönnberg) — Guanaco

Distribution. Guanacos reach their northernmost limit in the mountains of southern Peru. From here they range southward, sometimes at altitudes as high as 17,400 feet, along the Andes to Tierra del Fuego. I have not seen guanacos in Peru, but Osgood (1916) reported herds between Puno and Arequipa, Thomas obtained specimens from the Department of Cuzco (1920b), and Alberto Eduardo de Amat, the owner of several haciendas in southern Peru, informed me in 1946 that they were abundant in the Department of Moquegua, where they were frequently hunted. Sanborn was told that some were living near the coast west of Nazca, Department of Ica.

Description. Guanacos are wild relatives of the llama but with the bright tawny coloration of vicuñas. They are larger than the vicuña, however, and lack its white apron of long hairs on the breast. Their camelloid appearance, lack of antlers, and richer brown color distinguish them from huemuls. Depicted in Plate 62 of Cabrera and Yepes.

Habits. None observed.

32. VICUGNA VICUGNA VICUGNA (Molina) — Vicuña

Distribution. Vicuñas live in the high Andes of northern Chile, northern Argentina, Bolivia, Peru, and, according to Allen (1942), north to southern Ecuador. I have not encountered, however, any records of actual specimens from Ecuador. They are more abundant in the southern half of Peru than elsewhere. Almost all live above 13,000 feet. I have seen some at 17,000 feet, and the type locality of *V. v. mensalis* is at 17,700 feet.

Description. Vicuñas like the guanacos are wild relatives of the llama and alpaca. The back and sides are covered with a bright cinnamon-tawny fleece, and an apron of long white hairs hanging from the chest distinguishes them from their larger relative the guanaco. The vicuña's great brown eyes, supple neck, and slender legs give an impression of grace, beauty, and daintiness, while the motile ears express wariness and alertness. A pregnant female in the Museum of Comparative Zoölogy collection from the Department of Puno measured: total length, 1780; tail, 238; foot, 386; ear, 81; height at shoulder, 926; alveolar length of upper molar series, 57. An immature male from the Department of Puno killed late in December (probably about 10 months old) measured: length, 1440; tail, 200; foot, 50; ear, 108; height at shoulder, 810; length of upper molar series, 44. Toothrow measurements have been given above because *V. v. mensalis* from central Peru was described largely on the basis of its short molar series (45 mm.). The adult above has a toothrow even larger than the Argentine specimen mentioned by Thomas (1920b), so I have considered the Puno specimens to be *vicugna vicugna.* For illustrations see Cabrera and Yepes (Plate 63), Schmidt (1945), Thrapp (1946), and figs. 11–14 of this paper.

Habits. The writings about vicuñas have gradually become inbred almost to sterility by re-recording of folklore and old facts, most of which never had been firmly established. For example, many accounts mention "herds of young males" and "bands of females led by a male", but in no case does the author explain how he determined the sex of the animals — a distinction that I never was able to make from a distance. In many cases it is apparent that the author was relying neither on specimens nor on his own hunches, but on the writings of Tschudi (1844 and 1847), who has left us one of the best of the early accounts of vicuñas. Since I did not wish to kill any vicuñas, my notes are not based on as firm a foundation of specimens as would be desirable, but I have at least tempered my conclusions with scientific caution and have endeavored to make clear what is hearsay and what is actual observation.

RELATIONSHIPS

The true relationship between the domestic llamas and alpacas and the wild guanacos and vicuñas is controversial. I have seen llamas, alpacas, and vicuñas feeding in one motley group, and the first two scarcely raised their heads to see what had frightened away their timid cousins when I approached. Tschudi tells of seeing all four kinds grazing peacefully together. Sr. Alberto de Amat, the owner of several haciendas in southern Peru, has given me a photograph of a male alpaca mounting a female vicuña in the kneeling fashion characteristic of this group. Photographs show the alleged offspring of this cross to have the variegated color of the alpaca with a trace of the body conformation of the vicuña. Peruvians with whom I talked did not agree that these hybrids were fertile. Leon (1939), however, states that the offspring of such a cross are completely fertile both among themselves and with either parent. He states further that all the possible crosses of the four auchenids have been accomplished, that the hybrids of all are fertile, and he presents small photographs of the hybrids resulting from: llama x vicuña, llama x guanaco, llama x alpaca, and vicuña x alpaca.

ASSOCIATES

The most conspicuous vicuña neighbors at Caccachara are the viscachas. They do not compete appreciably for food, however, for the viscachas seldom venture far from rocky places, and the vicuñas rarely enter the rocks. I have seen a herd of vicuñas heed the high-pitched warning whistle that viscachas give when danger approaches.

Possibly the most important neighbors of the vicuña at Caccachara are the fossorial tuco-tucos (*Ctenomys opimus nigriceps*) that strip great patches of the already sparse hillsides. How much they compete with vicuñas for food is hard to say, for the tuco-tucos prefer the spiny grass, *Festuca orthophylla*, which is not that most favored by vicuñas, but after the tuco-tucos have removed the vegetation and moved on, other grasses than the original *Festuca* spring up, and these are more valuable to vicuñas. When rolling among and straddling the tola bushes fails to assuage all their itches, the vicuñas sometimes squirm and roll over and over, legs flying in every direction, in dust bowls prepared in the middle of these places bared by the tuco-tucos.

Largest and frequently least conspicuous of the neighbors at Caccachara are the rheas, *Pterocnemia pennata.* They are in many ways avian ecological twins of the vicuñas: they graze in open country and their safety depends upon their speed and alertness. Their great 3-toed tracks frequently mingle with and dwarf those of the vicuñas.

ENEMIES

One natural enemy of vicuñas is the mountain lion, or puma. I have seen its tracks as high as 17,000 feet in vicuña country and have found in its droppings the hair and the hoof-coverings of vicuñas, but pumas are scarce even in the remote mountains and probably do not seriously decimate the vicuña herds. Semi-wild dogs roam most of the high mountains of southern Peru, and twice I have seen them chase a band of vicuñas, but they were easily outdistanced. Indeed, Tschudi (1844) tells of a day-old vicuña outrunning for 3 hours hunters mounted on fast horses, and Thrapp (1946) recorded the speed of a vicuña as more than 35 miles an hour. Nevertheless, feral dogs probably take vicuñas by surprise at times.

The large Andean fox, *Dusicyon culpaeus andinus,* may kill occasional sick or crippled vicuñas. Man, however, is the greatest enemy of vicuñas. Despite strict laws protecting them, many are shot for their hides, their meat, or "sport". Few arrests are made because those possessing guns are frequently people who are influential or are otherwise immune.

NUMBERS

Vicuñas live in many parts of southern Peru but nowhere have I seen more of them than at Caccachara. We caught glimpses of them on the day that we arrived, and as the weeks went by they became accustomed to our presence. They drifted imperceptibly closer from day to day until on December 5, 4 months after our arrival, I awoke to see several bands totalling 37 vicuñas grazing within 100 yards of our tent. On another occasion I counted 63 vicuñas in 7 bands along a half-mile of the stream above our camp and a half-mile below.

Earlier in this paper population density near Caccachara was estimated at 1 vicuña to 120 acres; unfortunately, few other regions have as many.

The number of vicuñas in each band is almost constant from day to day and in most herds is between 3 and 25 with a mean of approximately 9. I counted 33 in one herd on December 11 as they filed up out of a gorge, and only 100 yards further on I came over a rise to surprise another band of 33. Schmidt (1945) mentions droves of a hundred or more.

HERD BEHAVIOR

Three bands of 12, 8, and 10 passed most of their time within three quarters of a mile of our tent at Caccachara. They could be found almost daily on the valley floor along the stream or on the slopes above it. Although these herds did not seem to have definite territories, the herd of 10 was usually further downstream than the others, and the herd of 12 further upstream. Despite numerous mixups these herds seemed to retain their identities as illustrated by the following incident:

Early on the morning of December 5 three herds of vicuñas, 12, 8, and 10 were grazing within 100 yards of our tent, each animal with its head down nibbling at the meager spears of tawny and green grass on the flats along the stream. Almost every morning these same three herds came down from the slopes and searched among the same grass tufts for succulent stems that perhaps they had missed yesterday or the day before. Intent on feeding, the three herds engaged in very little squabbling. But when a fourth herd of 7 appeared over the nearest ridge, the peaceful atmosphere broke. First the "leads" or "watch" animals, one from each herd, left their feeding and moved downstream toward the newcomers, walking with determined gait, ears cocked forward. Then one started to run, his long neck stretched forward, his head getting lower and lower. When a running vicuña's neck lowers to the horizontal, he is in a hurry; when it goes below horizontal, he is angry. This one was definitely angry, and several others had their ears back and their short tails raised. They too were excited. Ordinarily when two herds meet, the "lead" animals indulge in some mutual chasing back and forth, uttering a scream from time to time that sounds like the screech of auto tires rounding a fast turn, but their respective herds continue to graze or dust or bathe with scarcely a glance at the excitement. This morning, however, with 4 herds, 37 vicuñas, at rather close quarters, the excitement was contagious and infected every animal until each was eager to chase some other. And this is what happened. For a few minutes everyone seemed to be chasing everyone else. When the quarry of one dodged suddenly to one side, the pursuer, instead of following it, merely continued the pursuit after whomever happened to be ahead. There was very little screaming, and no damage was done. After a minute or two the excitement spontaneously subsided, and almost miraculously 4 distinct herds precipitated out of the mixup. I started to count and found that the upstream herd, which had started out with 12, now only numbered 9. But hardly had I finished counting when there was a resurgence of chasing in the middle, 3 vicuñas burst into the open and unconcernedly joined their 9 companions. At the close of hostilities, as before, 4 herds of 12, 8, 10 and 7 grazed peacefully on the flats along the river, but the herds were now spaced 100 yards apart instead of all being on the same 100-yard strip. Such mixups, which sometimes seem half in fun, are not for the purpose of kidnapping members of the other herd, but seem to be more in the spirit of "I was here first".

At other times squabbles arise because some vicuñas seem to enjoy a fight. On one occasion two herds were having a small squabble, the "leads" wrestling, chasing, and screeching at each other. A third "lead" standing with its band 200 yards downstream heard the excitement and headed upstream at a fast lope. The excitement had subsided by the time this one arrived, but it charged nevertheless into the two herds and milled around as if trying to start a fight. Failing in this it strutted gracefully and aloofly back to its herd — which had not even noticed its leader's absence.

Another vicuña succeeded in chasing and bluffing an entire herd of 10 into a pathetic huddle in the middle of the stream. They are not afraid of the water, however. On sunny mornings they frequently wade into deep places in the stream where they may stand for many minutes or kneel until the icy water almost covers their backs. They emerge with their legs appearing more slender than ever, and may kneel quietly in the sun while their fur dries.

After grazing for a time and drinking, a herd sometimes takes a mid-morning nap. On one such occasion most of the herd knelt or lay down while a few grazed nearby or kept watch. When about to lie down they go down on the front knees first, collapse the hindquarters, then drop onto the chest in front. The legs are tucked under the body. Of the napping animals mentioned above, some remained in this position with long neck upright on the alert, some rested their heads on the ground in front of them, and others sprawled flat on their sides with necks bent back like fossil ungulates in the death pose.

When fighting, two vicuñas sometimes stand facing each other, jabbing and wrestling with their long necks, or they may rear and strike with their front hooves, emitting at the same time high pitched screams or deeper growlings. When the vanquished takes to its heels it may kick with both hind feet, but despite this defense it may be run down and spilled from behind several times before it makes good its escape.

The squabbling that I have described between herds usually occurs when they are brought into close contact with each other near the stream. They come down from the slopes to drink, bathe, and graze on the tenderer grasses that grow on the floor of the valley. This concentration of herds leads to disputes and perhaps, after stomachs are full, to play between herds.

The most curious herd behaviour occurred on October 29. Vicuñas had been scarce near camp all day when 12 came down to the flat along the stream just after sunset. They seemed to be walking determinedly and hurriedly. They grazed quietly for a few minutes but when next observed were racing up and down the flat. All 12 would run in unison up the valley for about 200 yards, then wheel around and come back to within 100 yards of our tent. They completed perhaps 8 continuous laps in this fashion before they stopped — all at the same time. It was then almost dark. They did not seem to be chasing any individual, and although we were only 100 yards away we could hear no screaming or other sounds — not even the beat of their hooves on the soft earth.

One afternoon I was being driven back to camp before a cold wind sweeping down the valley from the continental divide, not looking to right or left, for each turn of the head exposed a tender cheek to the stinging shower of hailstones being driven almost horizontally by the wind, when I blundered on our familiar herd of twelve. All were lying on their bellies with feet tucked daintily under them. Like a dozen weather vanes all were facing downwind, some with their long necks stretched flat on the ground in front of them, some with their heads raised looking at me, and all of them liberally "thatched" with snow. I beat a course to one side and without disturbing them sailed home before the wind, chuckling at how much they looked like a dozen golden-brown cupcakes with vanilla icing. Only later did I wonder what whim of nature destined them to bear their young in another month in the middle of the wet season, quite possibly amidst a blizzard just like this one.

On another snowy evening I came just at dark onto a herd bedded down for the night on an open hillside. Each vicuña was lying a length or two from the next, but there was no orderly arrangement or orientation. All got up at my approach and moved off a few hundred yards to lie down again among the clumps of spiny grass.

Vicuñas cooperate in the construction of heaps of dung which are frequently about 8 feet in diameter and perhaps a foot high at the center, composed of small dry pellets or clusters of pellets. Similar heaps are made by alpacas and llamas. I doubt that the dung heaps are built at night, as suggested by Schmidt (1945), for I have many times during the day seen an entire herd, young and old, one by one approach one of these heaps, sniff, add to it, and depart.

FOOD

The *Festuca orthophylla* and other grasses of the slopes are largely passed by in favor of the *Calamagrostis nitidula* and *Festuca rigescens* near the streams. One vicuña stomach that I examined was stretched to the size of a basketball by 14 pounds of the brown culms of one or both of these two grasses. Flowers and foliage of dwarfed alpine flowers and crevice-growing plants probably are used for food occasionally, but grasses are the principal fare.

REPRODUCTION

We were told by numerous inhabitants that young vicuñas are born towards the end of January and that mating takes place a few months later. The females at Caccachara were almost certainly bred before our stay (July-December), for we saw no courting or mating behavior. The young were already half to two-thirds grown at the beginning of August.

One female died, apparently from an intestinal inflammation, only 100 yards from our tent on September 15. She was carrying a fetus which was 15 inches long and which weighed less than a pound, and she was at the same time lactating. Milk could be squeezed from each of the four small, crowded, inguinal nipples and was probably supplementary nourishment for a two-thirds-grown youngster that bedded down on the hill behind camp that night and seemed reluctant to move far away when approached. Many similar young vicuñas were mixed in the herds at this time, distinguishable by their smaller size and paler fleece with less white showing. They were seen nursing as late as October 1, which indicates a period of lactation of more than 7 months. Fetuses must have been quite large by December, yet I could not tell by studying the herds with binoculars which were the pregnant females. Yearlings could still be distinguished in December.

The fetus of the obliging female that expired on our doorstep was a male with eyes not yet open and no hair, although the adult color pattern was discernible in the skin. Its measurements were: length, 381; tail, 46; foot, 84; ear, 23. The fetus was carried in the left horn of the uterus, but it was the right ovary that contained the large corpus luteum; the left had several fairly large follicles but no corpus luteum.

The testes of a young male examined on December 29 were situated in the abdomen. This animal was probably either about 10 or 22 months old.

Orphaned vicuñas such as the one mentioned above are probably no longer dependent on their mothers for food, but they must suffer heavily from predation. Judging from the following incident, many herds probably would not accept this waif if it tried to join.

On September 7 a female and her nursing young[1] tried to join two different herds only to be driven off by inhospitable sentries despite the fact that each herd already contained young vicuñas as well as lactating females. One of these sentries was especially belligerent toward the youngster, and several times I saw these three streaking across the valley, the young one in front, the "sentry" charging it from the rear, and the mother helplessly following behind.

COMMERCIAL IMPORTANCE

Tschudi (1847) describes how the Indians drove wild vicuñas into enclosures a century ago and there killed some and sheared others before releasing them. Probably the Indians had been doing this for centuries to supply the royal Incas with the incomparably fine vicuña wool. The fact that the use of this wool was restricted to the royal families suggests that even in early times vicuña wool was a scarce commodity. Today some vicuña hides are being tanned and made into cloud-soft robes and some of the wool is being spun into yarn that finds its way into overcoats that are offered for sale in the United States for as much as 700 dollars (1948). But the supply is limited by the fact that few vicuñas are being raised in captivity and is limited even more by the fact that each vicuña can grow only a small amount of wool each year. Sr. Alberto Eduardo de Amat, a successful Peruvian sheep and alpaca rancher who has raised a few vicuñas told me that only 4 ounces of wool can be sheared each year and that the quality becomes coarser at each clipping. Attempts to combine the quantity of wool of the alpaca with the quality of vicuña by hybridization have not been particularly successful. It is possible that vicuñas will reach their greatest value as *wild* game animals capable of converting the sparse vegetation of extreme altitudes into delicious meat and into one of the finest fleeces in the world.

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[1] This may have been the same pair of which the mother was found dead on September 15.

DOMESTIC ANIMALS LIVING ON THE ALTIPLANO

Cat. It is well known that house cats do not do well at high altitudes. Monge (1942) reports that a tom cat taken from sea level to 15,000 feet became sterile and had no sperm or spermatogonia after 6 months. We saw one cat hunting in the hills above Pairumani at about 13,500 feet.

Dog. Domestic and semi-feral dogs were abundant at 16,000 feet and were lively enough at this altitude to chase vicuñas.

Cattle. We found a skull and droppings at Caccachara, 16,000 feet, possibly left from a herd that had been driven through the valley, but we were told that cattle did not do well above 13,500 feet. Many are raised in the region around Lake Titicaca.

Sheep. Despite their inability to adapt well physiologically to high altitudes, sheep are raised in great numbers up to 13,500 feet, and some are raised higher than this. They withstood being herded over the continental divide at Caccachara at an altitude of about 17,000 feet. Rams taken up from low altitudes are frequently sterile (Monge, 1943).

Swine. Pigs were being raised at Santa Rosa, 14,000 feet, but we saw none higher than this.

Llama and *Alpaca.* Llamas have survived in zoos at sea level, but in Peru they are worked only at high altitude, usually above 10,000 feet. They graze and carry packs at 17,000 feet, perhaps higher in some regions. Alpacas do best above 13,000 feet and can be pastured as high as there is food.

Horse, mule, and *burro.* All these animals are used up to 17,000 feet.

Rabbits. We were presented with two domestic rabbits while we were at Caccachara. They thrived for several weeks in a cage at this altitude (16,000 feet).

Domestic fowl. Hens were kept for meat and egg production at Pairumani, 13,000 feet.

OTHER MAMMALS POSSIBLY LIVING ON THE ALTIPLANO OF SOUTHERN PERU

Mustela frenata. Weasels skirt the eastern edge of the altiplano to as far south as Bolivia (Hall, 1939). I have found no clearly stated record of a weasel taken on the altiplano as I have defined it, although the following two accounts without precise localities might be acceptable as evidence. *M. f. macrura* Taczanowski was described from "the region of Lake Junin" (the lake itself lies at 13,200 feet), and *M. f. agilis* Tschudi was said to live on the cold, deserted, high plains of the cordillera. Tschudi (1844) mentions that this weasel was trained to capture viscachas, a fact that indicates that even if weasels did not originally live on the altiplano, they must have been taken there to find viscachas.

Oreailurus jacobita Cornalia. This scarce, long-haired cat, reminiscent of the snow leopard, has been taken from the high mountains near the junction of Chile, Argentina, and Bolivia.

Cavia nana Thomas. This pigmy cavy has been reported once from along the Desaguadero River between Lake Titicaca and Lake Poopo (Thomas, 1917). It is not unlikely, therefore, that it lives in Peru also.

Cavia (*Microcavia*) *niata* Thomas. Specimens of this species of the Caviella group have been taken near Mount Sahama and at other places on the altiplano of Bolivia, and it is possible that some race of *niata* ranges into Peru.

Chinchilla lanigera brevicaudata Waterhouse. The geographical limits of the Peruvian subspecies have never been determined, but it seems to have been most abundant at moderate altitudes on the western slopes of the Andes in southern Peru. It almost certainly lived on the altiplano at one time. I found no trace of chinchillas and think that they are extinct in Peru, although most of the inhabitants of the region believe that chinchillas still live there in one of those three elusive localities: "mas adentro", "mas arriba", or "mas allá".

Octodontomys gliroides (Gervais and d'Orbigny). The recent finding of this mouse in the mountains of northern Chile (Mann, 1945), coupled with numerous records from the altiplano in Bolivia, suggests that it may also be found in southern Peru.

Galenomys garleppii (Thomas). This mouse has been caught only at Mount Sahama, in Bolivia, but since this is part of the altiplano and since other characteristic elements of the Sahama fauna such as *Chinchillula* and *Akodon berlepschii* find their way into Peru, it is not unlikely that *Galenomys* will some day be taken in Peru.

Mus musculus. I have captured house mice in the city of Cuzco, 11,400 feet, but, curiously, they have not yet been reported from the altiplano. White mice live and reproduce normally at least as high as 14,260 feet (Moore and Price, 1948).

Chaetophractus nationi (Thomas). The recent capture of this armadillo by Mann (1945) at high altitude in northern Chile suggests that it may also occur on the altiplano of Peru.

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PLATES

PLATE 1

Fig. 1. View looking eastward across the Caccachara Valley, 16,000 feet. December 10, 1949. The floor of this valley provided grazing for great numbers of vicuñas, and the cliffs and rock slides on this slope of 17,400-foot Cerro Ichuasi sheltered more than 250 viscachas.

PLATE 2

Fig. 2. Map of a portion of the altiplano. Land area below 12,000 feet is stippled. Heavy solid line shows boundaries between Peru, Bolivia, and Chile. Based primarily on the American Geographical Society 1:1,000,000 Map of South America.

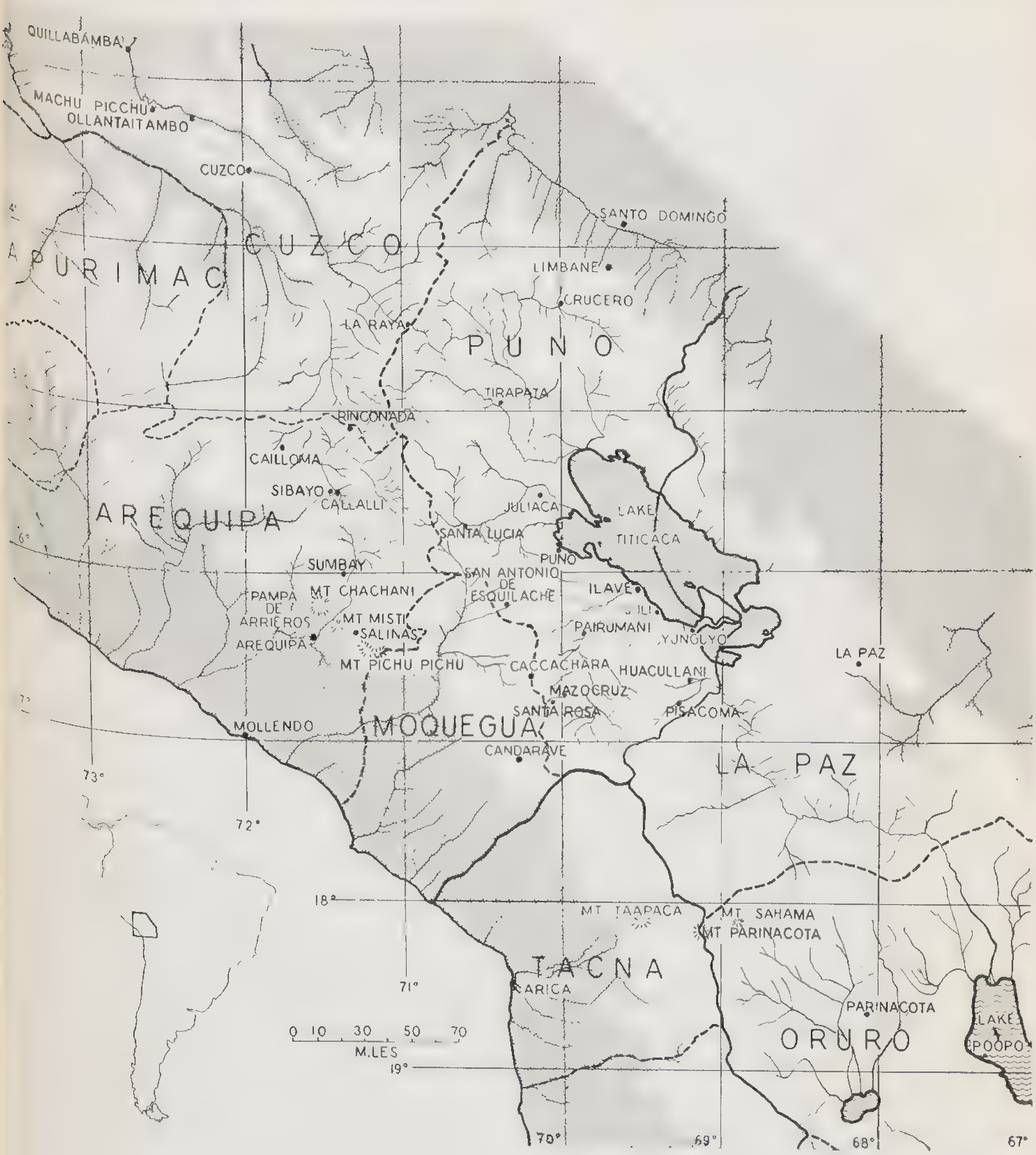
QUILLABAMBA
MACHU PICCHU
OLLANTAITAMBO
CUZCO
CUZCO
APURIMAC
SANTO DOMINGO
LIMBANE
CRUCERO
LA RAYA
PUNO
TIRAPATA
RINCONADA
CAILLOMA
SIBAYO
CALLALLI
AREQUIPA
JULIACA
LAKE
TITICACA
SANTA LUCIA
PUNO
SUMBAY
SAN ANTONIO DE ESQUILACHE
ILAVE
JULI
PAMPA DE ARRIEROS
MT CHACHANI
MT MISTI
SALINAS
AREQUIPA
PAIRUMANI
YUNGUYO
LA PAZ
MT PICHU PICHU
CACCACHARA
HUACULLANI
MAZOCRUZ
SANTA ROSA
PISACOMA
MOLLENDO
MOQUEGUA
CANDARAVE
LA PAZ
73°
72°
18°
MT TAAPACA
MT SAHAMA
MT PARINACOTA
TACNA
71°
ARICA
PARINACOTA
0 10 30 50 70
MILES
ORURO
LAKE POOPO
19°
70°
69°
68°
67°

PLATE 3

Fig. 3. Grassy slopes at Hacienda Pairumani, 13,000 feet. Among these clumps of grass lived *Akodon boliviensis*, *A. amoenus*, *Hesperomys ducilla*, and *Phyllotis pictus*.

Fig. 4. Rock outcroppings along the Rio Huanque south of Hacienda Pairumani, 13,500 feet. Huemuls lived among these rocks.

PLATE 4

Fig. 5. Cliff and boulders at Hacienda Pairumani, 13,000 feet. See also figure 14. Traps along the base of the cliff caught both rock-loving and grass-loving forms: *Lagidium peruanum*, *Phyllotis darwinii* subsp., *P. osilae* subsp., *Chinchillula sahamae*, *Akodon boliviensis*, and *A. berlepschii*.

Fig. 6. A specimen of *Polylepis tomentella* at Santa Rosa, 14,000 feet. Among the grass and tola in the foreground lived *Eligmodontia puerulus hirtipes* and *Akodon berlepschii*.

PLATE 5

Fig. 7. Santa Rosa, 14,000 feet. A cluster of rocks about 5 feet high in tola desert. *Akodon andinus lutescens*, *Hesperomys ducilla*, *Phyllotis darwinii* subsp., and *P. sublimis*, lived among these rocks. The principal plants were two kinds of tola (*Lepidophyllum quadrangulare* and *Baccharis incarum*), thorn bush (*Margyricarpus strictus*), and *Opuntia*.

Fig. 8. Caccachara, 16,500 feet. A group of coral-like heads of yareta (*Azorella yarita*), an Umbellifer that has assumed the cushion shape so characteristic of many plants of the high parts of the altiplano.

PLATE 6

Fig. 9. Juli, 12,500 feet. View along the shore of Lake Titicaca. Among these rocks and bushes live *Cavia musteloides*, *Phyllotis darwinii* subsp., and *Andinomys edax edax*.

Fig. 10. Caccachara, 16,000 feet. Plains covered with *Festuca orthophylla*. Vicuñas, rheas, and tinamous live here, as well as *Phyllotis sublimis*, *P. boliviensis flavidior*, and *Ctenomys opimus nigriceps*.

10

PLATE 7

Fig. 11. Wild vicuña at Caccachara. Note the white apron that helps to distinguish vicuñas from guanacos.

Fig. 12. A tamed vicuña resting at Hacienda Pairumani.

Fig. 13. A wild herd of vicuñas between Santa Rosa and Caccachara, 17,000 feet.

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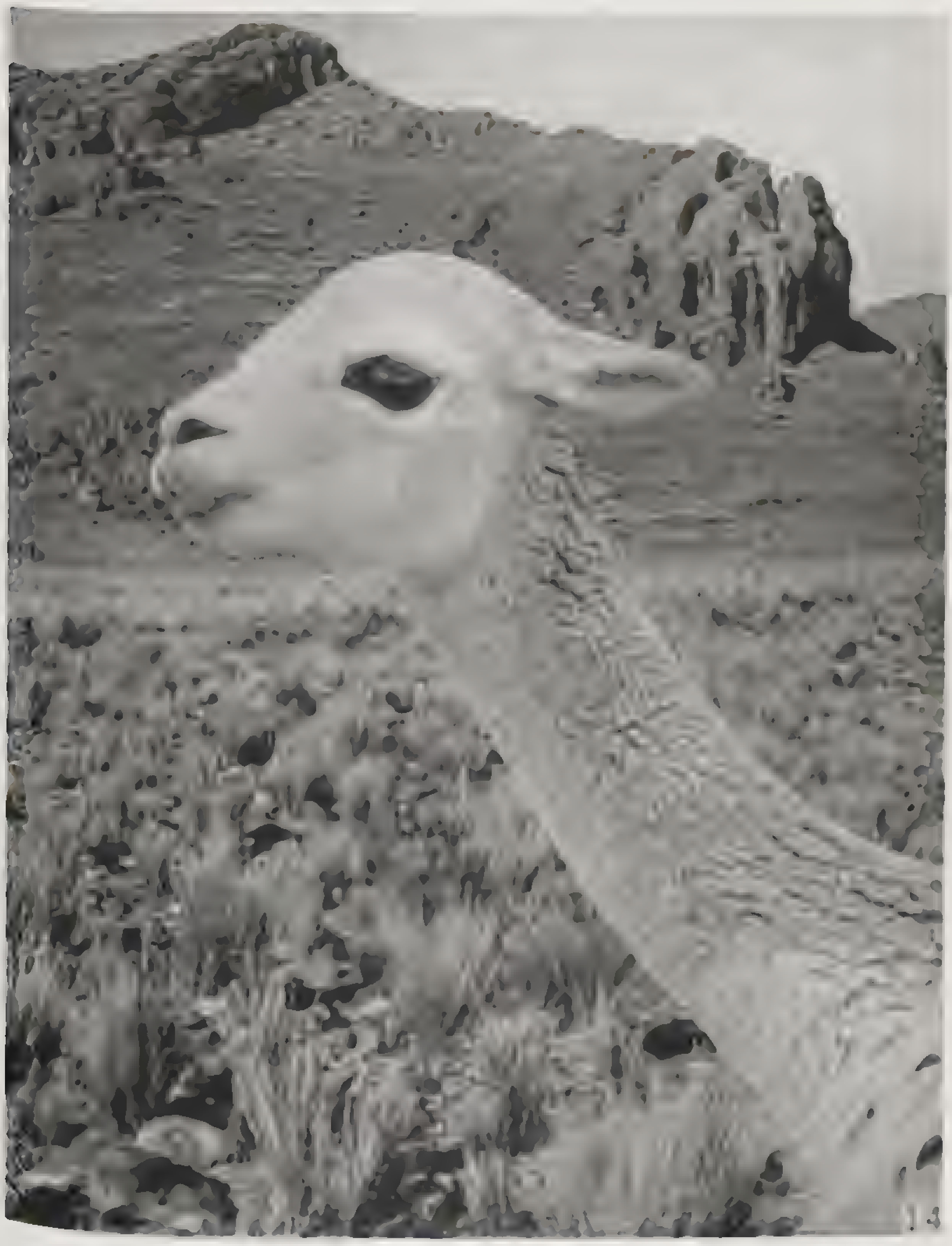
PLATE 8

Fig. 14. Portrait of a tamed vicuña at Hacienda Pairumani. The photograph reproduced in figure 5 was taken at the base of the cliff in the right background.



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ON REPTILES AND AMPHIBIANS FROM TANGANYIKA TERRITORY

COLLECTED BY C. J. P. IONIDES

By Arthur Loveridge

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
June, 1951

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No. 4. — *On Reptiles and Amphibians from Tanganyika Territory Collected by C. J. P. Ionides*

By Arthur Loveridge

Mr. Ionides, whose keen interest in the herpetofauna of Tanganyika is well known to residents of that territory, has presented the collections he has made to several museums. One of these collections was the basis of a recent article (1950. Ann. Mag. Nat. Hist. (12), **3**, pp. 413–417) by Mr. C. J. Battersby of the British Museum (N. H.). The present paper deals with material from the Kilwa-Lindi-Liwale-Tunduru-Songea area in the Southern Province of southeast Tanganyika Territory. Herpetologically this region, more particularly Liwale and Tunduru, are among the least known of Tanganyika's savanna areas, a fact reflected by the number of interesting finds made by Mr. Ionides.

Among these discoveries invitation is drawn to the new amphisbaenid described by Battersby, the new dwarf chameleon (*Brookesia ionidesi*), the first record for Tanganyika of a rare blind snake (*Typhlops tettensis ? obtusus*), the new race (*Chilorhinophis carpenteri liwalensis*) of a Mozambique burrowing snake, and the new form of a Congo burrowing snake (*Amblyodipsas katangensis ionidesi*) that I take pleasure in naming after its industrious discoverer, the first to find a member of this genus in Tanganyika. Also included are descriptions of other new snakes collected by the author.

An earlier collection of snakes made by Ionides in the Southern Province, was identified by Professor Augusto Toschi of the Coryndon Memorial Museum, Nairobi, and most unfortunately was published in 1947 (Game Dept. Tang. Terr. Ann. Report 1945, pp. 6–8). This list is likely to result in endless confusion if quoted or copied by uninformed compilers of faunal check lists. Not only are the misspellings too numerous to mention, but certain determinations exhibit little understanding of the habitat preferences and possibilities of the reptiles involved.

Through the courtesy of Dr. L. S. B. Leakey, Director of the Coryndon Museum, I was able to examine one of the mambas on which the record of "*Dendroaspis jamesoni kaimosae*" was based. It proved to be quite a typical example of the common green mamba (*Dendroaspis angusticeps*). That Gold's cobra (*Pseudohaje goldii*) occurs near Liwale is almost as astonishing; unfortunately the specimens were not preserved. It may be presumed that the record of the very local "*Elapsoidea sundervalli* (sic) *nigra*" was based on an adult of the lowland *E. sundevallii decosteri*. I have little doubt that the alleged specimen of "*Thrasops jackson*" (sic) was a common boomslang (*Dispholidus typus*). What the reptile was that is recorded as "*Typhlops graveri* (sic) *gracilis uluguruensis*" it would be idle to speculate but that it is one of the three species mentioned is unlikely.

Subspecific and other allocations are also questionable, so it is to be sincerely hoped that the list will be used with the greatest reserve, and that the Game Department will realize its responsibility in subjecting to careful proof-reading the articles published in their Annual Report.

Unfortunately the first consignment submitted by Mr. Ionides suffered during transit; from its macerated material skulls alone were saved. For their skillful preparation, as also for the figure of the amphisbaenid paratype, I am indebted to Dr. Paulo E. Vanzolini. I am also grateful to Dr. G. F. de Witte for information concerning, and the Directors of the Institut Royal des Sciences Naturelles de Belgique and National Museum of Southern Rhodesia for the loan of *Chilorhinophis* material that has enabled me to complete the description of *Chilorhinophis gerardi tanganyikae* subsp. nov. Specimens of *Chilorhinophis* were also lent by Dr. H. W. Parker and Mr. C. J. Battersby of the British Museum who, as usual, have been most generous in supplying information regarding specimens in their care. For identifying stomach contents I wish to thank my entomological colleagues, Drs. J. C. Bequaert, P. J. Darlington, Jr., and W. L. Brown.

In the following discussion of the material, the lizards are arranged more or less in accordance with Camp's classification of saurian families. In the notes on snakes I have given a few Ngindo names collected by Mr. Ionides, who has also kindly permitted me to include some of his interesting observations on habits as culled from our correspondence.

Hemidactylus mabouia (Jonnés)

♂ (M. C. Z. 50002) Lindi District. 23.xii.47.
6 ♂♂, 4 ♀♀ (M. C. Z. 51262–3) Liwale. 4–8.xi.49.

Preano-femoral pores of males 48–52.

Lygodactylus picturatus picturatus (Peters)

♂ (M. C. Z. 50003) Tunduru, Lindi. 10.x.48.

Snout to vent 41 mm., tailless.

PACHYDACTYLUS BIBRONII TURNERI (Gray)

♀ (M. C. Z. 50004) Ruponda, Lindi District. 9.i.48.
♂, 2 juv. (M. C. Z. 51264) Liwale District. 3–4.xi.49.

The ♂ is a record, its total length being 177 (92 + 85) mm., the ♀ measures 94 mm. from snout to vent, but her tail is regenerating.

AGAMA MOSSAMBICA MOSSAMBICA Peters

11 ♂♂. 23 ♀♀ (M. C. Z. 50005, 51271–85) Liwale. 9.vii.48 & 2.xi–5.xii.49.
skulls of ♂ ♀ (M. C. Z. 50115–6) Lindi District. 30.xi. & 28.xii.47.
♂ ♀ (M. C. Z. 50192–3) N. E. Songea District. 5.viii.49.
♀ (M. C. Z. 50194) Tunduru District. 24.vii.49.

Midbody scale-rows 70–82; the adpressed hind limb reaches to the (♀) shoulder or temporal region (♂); preanal pores in ♂♂, 13–15; when an anterior supernumerary series is present it has been ignored. Many other data have been collected from this fine series for future use. Dusky gular networks are overlaid with pale blue in ♂♂, gray blue in ♀♀; basal gular and antebrachial patches black, rather more conspicuous in males. Largest ♂ (M. C. Z. 51271), 304 (105 + 199); largest ♀ (M. C. Z. 51272), 255 (100 + 155) mm. The females taken in November are almost all gravid, the eggs apparently being laid by mid-December, i.e. towards the end of the rains. On December 5, an obviously full-time ♀ held nine eggs each about 17 x 6 mm., in addition to a second series of developing ova, each approximately 4 mm. in diameter. Mites (*Pterygosoma* sp.) of an orange-red hue are present beneath the ventral scales of almost every lizard of both sexes.

AGAMA CYANOGASTER (Rüppell)

♀ skull (M. C. Z. 50117) Liwale. 30.i.48.
♂ ♀ (M. C. Z. 50188–9) Liwale. 9–13.v.49.
juv. ♂ ♀ (M. C. Z. 50190–1) N. E. Songea. 5.viii.49.

The skull was from a dried-out specimen with blue throat, gravid, the 13 ova devoid of embryos averaged about 22 x 14 mm. This is the common arboreal agama long known as *atricollis* A. Smith.

BROOKESIA IONIDESI sp. nov.

Type. Museum of Comparative Zoölogy, No. 51301, a gravid ♀ from Kilwa, Southern Province, Tanganyika Territory. Collected by C. J. P. Ionides, Esq., January, 1949.

Paratypes. Museum of Comparative Zoölogy, Nos. 50100, 51302–3, 51356–63, and five duplicates, being five ♂♂ and 12 ♀♀ from Kilwa, taken in January, 1949, and between February 19 and March 7, 1950. Also M. C. Z. Nos. 51304, 51351–5, and four duplicates, being one ♂ and nine ♀♀ from Liwale, Southern Province, Tanganyika Territory. Collected by Mr. Ionides on October 29, 1949, and between February 19 and March 8, 1950. A selection of the duplicates was presented by Mr. Ionides to the British Museum.

Remarks. Parker (1942, Bull. Mus. Comp. Zoöl., **91**, p. 80, fig. 8) prefers to retain *Rhampholeon* for the continental forms of the Malagasy genus *Brookesia* on osteological grounds. Until, however, it has been demonstrated that the skeletal differences he describes are generally characteristic of their respective groups, instead of an individual species selected from each, I continue to refer all pigmy chameleons to the older name *Brookesia.* All except one of the mainland species and races of the genus are well represented in the Museum of Comparative Zoölogy, and a key based on a study of this material is provided below.

Apparently *B. ionidesi* is a lowland form in the Southern Province for a re-examination of M. C. Z. 47300, recovered from the stomach of a *Chlorophis macrops* on the Rondo Plateau, near Lindi, confirms my original identification of it with *brevicaudata* (1942e, Bull. Mus. Comp. Zoöl., **91**, p. 371) for it plainly shows the characteristic beard-like tuft of scales on the chin.

Diagnosis. B. ionidesi is a pigmy chameleon intermediate between *brevicaudata* of Tanganyika Territory and *brachyura* of Nyasaland. Having been compared with near topotypes of both it is found to differ from *brevicaudata* in lacking the characteristic beard-like tuft or tufts of scales on the chin, and in possessing a higher supraciliary process. From *brachyura* it differs in the absence of a flexible rostral appendage, and in possessing longer and more slender claws. In this latter character as well as in possessing axillary pits *ionidesi* approaches *platyceps* but comparison with a topotype of this species reveals that *ionidesi* lacks an inguinal pit and differs in other ways.

Description. Holotype ♀. Snout without a dermal appendage; upper lip directed downwards; a strong canthal ridge continuous with the high supraciliary crest that is extended posteriorly around the orbit as a series of large, well-spaced granules, which are united with another series of granules that form a prominent horizontal line across the temporal region; on the occipital region are a few scattered granules, some aligned so as to suggest a low parietal crest; vertebral line indistinctly crenulate but its component granules not, or but slightly, enlarged and undifferentiated, resembling those on the flanks; chin without tufts of enlarged scales, all granules on the lower surface being substantially homogeneous; a deep axillary but no inguinal pit; limbs exhibit a few, scattered, enlarged and rather spine-like granules; scales on soles spinose but no long isolated spines at the base of the digits; claws relatively long, slender, and bicuspid (occasionally somewhat indistinctly); tail short, being included 6.2 (4.5–5.6 in paratype ♂♂, 6–8, possibly 9 if tail intact in M. C. Z. 51353, in paratype ♀♀) times in the total length.

Color. The drab brown tones (rarely white in preserved specimens), common to members of this genus, are frequently varied by a series of darker, longitudinal, lateral bands, sometimes light-edged, extending from head to tail, the broadest passing through the eye; between these bands regular series of well-defined, well-spaced, conspicuous, black spots are often displayed by adult females.

Size. Total length of holotype ♀ (M. C. Z. 51301), 58 (50 + 8) mm., of paratype ♂ (M. C. Z. 51356), 43 (33.5 + 9.5) mm. This species is much the smallest of all known mainland *Brookesia.*

Breeding. The type, taken in January, holds fully developed eggs about 9.5 x 4.5 mm. in size. All ♀♀ taken between mid-February and early March, both at Kilwa and Liwale, are gravid, but their ova exhibit wide variation in the degree of development as will be seen by the following figures.

Date collected	*Number of eggs*	*Approximate size*	*Locality*	*Ionides No.*
February 20	10	8 x 5 mm.	Liwale	1915
" 22	10	5 x 4 mm.	"	1929
" 25	10	8 x 4.5 mm.	Kilwa	1994
March 1	11	8 x 4 mm.	"	1997
" 1	14	3.5 x 3.5 mm.	"	1999
" 8	12	8.5 x 5 mm.	Liwale	2005

Diet. Stomach contents, as determined by Dr. P. J. Darlington, Jr., consisted of tiny wings of ants or flies; orthoptera, some cricket-like; two spiders; two sowbugs; and a small snail (*Pseudoglessula* sp.) identified by Dr. J. C. Bequaert.

Key to the African Species of the Genus BROOKESIA

1. No dermal appendage on snout; no long isolated spines on palms at base of digits..2.

A small (sometimes almost minute) flexible rostral appendage; vertebral line and dorsal surface of tail weakly crenulate........................5.

2. No pit beneath forearm; vertebral line and dorsal surface of tail smoothly rounded...3.

A small axillary pit present; vertebral line and dorsal surface of tail weakly crenulate; claws of hand usually with faintly indicated secondary cusp.4.

3. Claws of hand simple, without even an indication of a secondary cusp; bony supraciliary process about equal to two-thirds the orbital diameter in males, half or less in females; range: British and Italian Somaliland.... *k. robecchii* (Boulenger)

Claws of hand with strong secondary cusp; bony supraciliary process about equal to half the orbital diameter in both sexes; range: Kenya Colony and Tanganyika Territory..........................*k. kerstenii* (Peters)

4. One or two beard-like tufts of scales on chin; bony supraciliary process very low; range: Tanganyika Territory.............*brevicaudata* (Matschie)

No beard-like tufts of scales on chin; bony supraciliary process higher; range: Tanganyika Territory..........................*ionidesi* sp. n.

5. Long isolated spines on palms at base of digits; a small axillary pit present.7.

No long isolated spines on palms at base of digits; a small axillary pit present or absent...6.

6. No pit beneath forearm nor in groin; at regularly spaced intervals along vertebral line are but slightly enlarged granules; claws shorter and stouter than in *platyceps;* range: Tanganyika Territory; Mozambique; Nyasaland..................................*brachyura* (Günther)

A small pit beneath forearm *and another in groin;* at regularly spaced intervals along vertebral line are groups of enlarged spine-like granules; claws longer and more slender than in *brachyura;* range: Nyasaland.......... *platyceps*[1] (Günther)

7. Claws of hand with faintly indicated secondary cusp; bony supraciliary crest very low; no beard-like tufts of scales on chin; range: Tanganyika Territory..................................*temporalis* (Matschie)

Claws of hand with strong secondary cusp; supraciliary crest prominent with anteriorly-directed dermal process.............................8.

8. Adult males under 65 mm., gravid females under 61 mm.; a race intermediate in development between *brachyura* and the other forms of *spectrum;* range: western Uganda and eastern Belgian Congo.................. *s. boulengeri* (Werner)

Adult males over 75 mm., gravid females over 69 mm.................9.

9. Rostral process less than 2 mm. in length; tail of male 4 to 4½ times in total length, that of the female 4⅓ to 5⅓ times; range: Belgian Congo...... *s. affinis* (Steindachner)

Rostral process 2 mm. or more in length; tail of male 3 to 3½ times in total length, that of the female 3¾ to 4¼ times; range: French Congo; Cameroons; Fernando Po ....*s. spectrum* (Buchholz)

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[1] Here also would fall *Chamaeleo marshalli* of Southern Rhodesia, which, though originally described as a *Rhampholeon* on account of its bicuspid claws, possesses the prehensile tail and other characters of *Chamaeleo.*

MABUYA MACULILABRIS MACULILABRIS (Gray)

♀ (M. C. Z. 50006) Lindi District. 30.xii.47.

Supraciliaries 5–5. Dried. Total length 183 (73 + 110) mm.

MABUYA MACULILABRIS BOULENGERI Sternfeld

♂ (M. C. Z. 50007) Liwale. 7.vii.48.

Supraciliaries 4–4. Total length 215 (74 + 141) mm.

MABUYA PLANIFRONS (Peters)

♂ (M. C. Z. 51268) Liwale District. 4.xi.49.

Supraciliaries 6–6. Total length 312 (120 + 192) mm.

MABUYA VARIA VARIA (Peters)

3 ♂♂, 3 ♀♀ (M. C. Z. 50008, 51270) Liwale. 14.vii.48 & 5–28.xi.49.

Total length of one ♂, 136 (48 + 88) mm., and a ♀, 129 (51 + 78), the latter gravid with large ova on November 5.

MABUYA STRIATA (Peters)

4 ♂♂, 3 ♀♀ (M. C. Z. 51269) Liwale District. 4–8.xi & 2.xii.49.

None of the series is of exceptional size, all rather poorly preserved.

RIOPA SUNDEVALLII (A. Smith)

♀ (M. C. Z. 50009) Liwale District. 12.vii.48.
skull (M. C. Z. 50119) Ruponda, Lindi District. 8.i.45.

The latter from one of a pair of dried-out specimens.

MELANOSEPS ATER RONDOENSIS Loveridge

juv. (M. C. Z. 50010) Liwale. 15.v.48.

Midbody scale-rows 18. Snout to vent 85 mm. As the tail is regenerated this limbless lizard cannot be subspecifically identified, but a perfect adult, later taken at Liwale by Ionides, is unquestionably *rondoensis*. Rather surprisingly, an adult (81 + 24 mm.) and four young (ranging from 30.5 + 12.5 to 34 + 12 mm.), recently collected by Dr. F. X. Williams at Diani Beach, 20 miles south of Mombasa, Kenya Colony, are referable to this short-tailed race.

GERRHOSAURUS NIGROLINEATUS NIGROLINEATUS Hallowell

♀ (M. C. Z. 50014) Lindi District. 30.xii.47.

At Ruponda, Lindi District, another of these large lizards had been swallowed by an adult Cape File Snake (*Mehelya c. capensis*).

HOLASPIS GUENTHERI Gray

3 (M. C. Z. 50011–3) Liwale District. 11.vii.–4.viii.48.

Midbody scale-rows 80–90, of which 6 are ventrals. Total length of largest, a ♀ (M. C. Z. 50013), 111 (47 + 64) mm.

These arboreal lizards, of which Mr. Ionides says he has collected about ten, constitute a southward extension of the range within Tanganyika of about two hundred miles. One was taken six miles west of Liwale Boma in the valley of the Liwale, others in the western part of the district on the upper reaches of Mangi River. Yet another near Nahata River just across the border in Tunduru District. Both these rivers are tributaries of the Njenje. The country they inhabit is of the ordinary Myombo savanna type where they live on trees in crevices of whose bark they seek refuge when disturbed. The solitary exception was one taken on the ground in Mr. Ionides' tent. The records help to bridge the gap between those from Tanganyika's montane forests and the isolated ones from Zomba and the Zambezi.

AMPHISBAENA IONIDESII Battersby

Amphisbaena ionidesii Battersby, 1950, Ann. Mag. Nat. Hist. (12), **3**, p. 413: Liwale, Southern Province, Tanganyika Territory. The Lat. and Long., given as "10° N. + 3° 8′ W." are actually 9° 45′ S., 37° 55′ E.

25 (M. C. Z. 50015–39) Tunduru. 7.xii.48.
147 (M. C. Z. 50040–64) Liwale District. 2.iv-13.v.48.
2 skulls (M. C. Z. 50120) Liwale District. iv.48.

Native name. Luhakwe (Ngindo).

There is little to add to Mr. Battersby's excellent and detailed description of this well-differentiated form. In our series the prefrontals are in contact with the first labials in 142 specimens, excluded in 20, and excluded from the ocular in about a dozen instances; there are a pair (fused into a single scale in 3 cases, viz. M. C. Z. 50015; 50028; and one uncatalogued; or two pairs in M. C. Z. 50030 only) of small, scarcely-differentiated parietals; annuli on the body 224–252, on the tail 22–27, while segments in a midbody annulus range from 24–30 (10–14 + 14–16), these statistics being based on counts made on the 50 catalogued lizards (25 Tunduru; 25 Liwale) of which the Liwale ones only are paratypes. The largest (M. C. Z. 50062) measures 194 (171 + 23) mm.

In my "Revision of the African Lizards of the Family Amphisbaenidae" (1941, Bull. Mus. Comp. Zoöl., **87**, p. 406) I commented on the fact that when an amphisbaenid discards its tail the truncated stump, in healing, becomes rounded off so as to leave little evidence of autotomy. There are a number of specimens with such truncated tails in the magnificent series collected by Mr. Ionides, and it is of interest to observe that the division invariably occurs at the ninth or tenth annulus posterior to the anus. Were this fact overlooked such a series of specimens with abbreviated tails might lead one to postulate a short-tailed race.

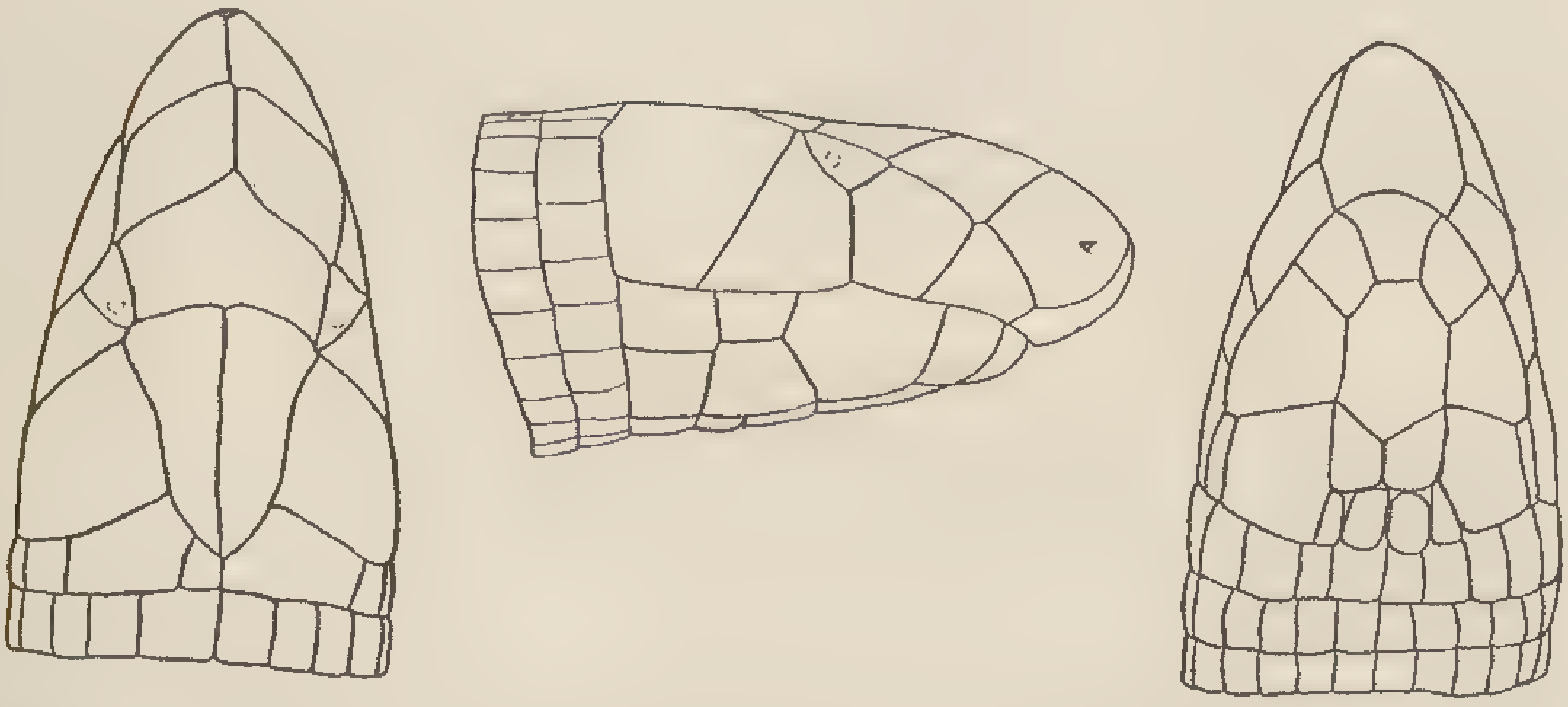

Fig. 1. *Amphisbaena ionidesii* Battersby (Paratype ♀ M. C. Z. 50040).

An example of this is furnished by *Amphisbaena albissima* Amaral of Brasil, and in drawing attention to it Dr. P. E. Vanzolini (1948, Rev. Brasil Biol., **8** (3), p. 389, figs. 7–9) publishes figures of truncated tails, observing that in *A. mertensii* Strauch, with which he synonymizes *albissima*, fissuring occurs always between the seventh and tenth caudal annuli.

FitzSimons (1943, Transvaal Mus. Mem. No. 1, p. 380) is doubtless correct in reviving *vandami* as a race of *violacea*, to whose synonymy I had relegated it. In this connection I examined the post-temporal scales of the entire series of *ionidesii* listed above, and observed that in a random sample of 65 Liwale lizards the posterior margin of the temporal bordered on 3, 4, or 5 scales in the proportion of 25–35–5.

Ionides informs me that he obtained many of these worm-like lizards through digging where they had betrayed their presence by pushing up little heaps of still damp black cotton soil in areas from which the river had recently receded. One amphisbaenid was recovered from the stomach of a snake (*Chilorhinophis carpenteri liwalensis* — M. C. Z. 50077) and another from a burrowing viper (*Atractaspis bibronii* — M. C. Z. 50096).

CORDYLUS CORDYLUS TROPIDOSTERNUM (Cope)

♂♂, ♀ (M. C. Z. 50065, 51265–7) Liwale District. 8.vii.48 & 5.xi.49.

Sexing by collector prior to removal of viscera. Femoral pores 7 + 7, but 2–4 apertures present on some of the scales. Total length of larger ♂, 171 (92 + 79) mm., of gravid ♀, 153^+ (95 + 58^+) mm. This ♀, taken on November 5, holds a single embryo (M. C. Z. 51267), fully scaled and measuring 73 (40 + 33) mm. Consequently it occupied much of the body cavity but still the stomach was distended with a large cockchafer (Scarabaeidae) besides fragments of another and two ants; one a worker (*Crematogaster* sp.), the other a minor worker (*Pheidole* sp.). For these identifications I am indebted to Dr. W. L. Brown.

TYPHLOPS SCHLEGELII MUCRUSO (Peters)

2 (C. M. M. 795–6) Liwale. 1945.
7 (M. C. Z. 48799, 50067, 51286–7, 51306–8) Liwale. ix.45; iii.49; 20.xi.49; 12–15.xii.49.

Native name. Mbito (Ngindo, but applied to *Leptotyphlops* also).

Midbody scale-rows 30–34; midbody diameters 4.25–19 mm. being included 25.5 to 41 times in total length. It is interesting to note that of the two very young ones taken on November 20, one is of the lineolate, the other of the blotched form. The total length of the smallest (M. C. Z. 41286) is 120 (118 + 2) mm., of the largest (M. C. Z. 50067), 486 (480 + 6) mm. The head of this large blind snake was in the mouth of a "thirty-two-and-a-half-inch" *Calamelaps unicolor warreni*, while from the stomach of another *warreni* a younger *Typhlops* was recovered.

TYPHLOPS TETTENSIS ? OBTUSUS Peters

Typhlops (*Onychocephalus*) *obtusus* Peters, 1865, Monatsb. Akad. Wiss. Berlin, p. 260, pl. —, fig. 2: Shire River, Mozambique.

1 (M. C. Z. 50066) Liwale. 24.i.48.

Preocular in contact with second and third labials, ocular with third and fourth; midbody scale-rows 22; midbody diameter 6 mm. is included 44.5 times in total length. Total length 266 (262 + 4) mm.

This snake, unless representing an undescribed form, the first example of the race I have seen and the first to be taken in Tanganyika Territory, agrees with the form as defined in my key (1942. Bull. Mus. Comp. Zoöl., **91**, p. 257) except that the rostral *does* extend back to an imaginary line level with the anterior borders of the eyes, which *are* distinguishable, and the underside is bluish-gray like the back, but lacking the dusky edging of the dorsal scales.

Most unfortunately on page 256 of this key is an error where it should read: "Preocular in contact with the second labial only". It is the ocular that is in contact with the second, third and fourth labials, both in *t. tettensis* and *t. rondoensis*.

LEPTOTYPHLOPS CONJUNCTA CONJUNCTA (Jan)

1 (M. C. Z. 50068) Ruponda, Lindi District. 10.i.48.
1 (M. C. Z. 51305) Liwale District. 11.xi.49.

Native name. Mbito (Ngindo, but applied to *Typhlops* also).

Above black; diameter 2–2.5 mm., included 50–63.5 times in total length. Total length of M. C. Z. 50068, 159 (146 + 13) mm., so tail is included 12.2 to 14.2 times.

LEPTOTYPHLOPS LONGICAUDA (Peters)

1 (M. C. Z. 50069) Liwale. 11.vii.48.

Above pale brown; diameter 2 mm., included 57 times in total length. Total length 114 (101 + 13) mm., so tail is included 8.7 times.

NEUSTEROPHIS OLIVACEUS ULUGURUENSIS (Loveridge)

5 ♂♂, 4 ♀♀, & skull (M. C. Z. 50243–8) Liwale. 16–17.x.49.
♀ (M. C. Z. 51288) Songea. vii–x.49.

Midbody scale-rows 17, except for two (M. C. Z. 50245, 51288) with 15; ventrals 132–140; subcaudals 69–84; labials 7–8, the third, fourth and fifth, or fourth and fifth, entering the orbit; preocular 1; postoculars 2 (left side of M. C. Z. 51288 only) or 3; temporals 1 + 1, 1 + 2, or 2 + 1. Both sexes are represented by gray and by pinkish-brown individuals. None is of outstanding size, five having lost the end of their tails as is so frequently the case with this marshland species.

This series includes the second and third mainland specimens to be recorded with 15 midbody scale-rows, characteristic of the insular race *pembana* (cf. Loveridge, 1942e, Bull. Mus. Comp. Zoöl., **91**, pp. 261–2).

BOAEDON LINEATUS LINEATUS Duméril & Bibron

♂ (M. C. Z. 51289) Songea. vii–x.49.

Midbody scale-rows 27; ventrals 200; subcaudals 62; labials 8, the fourth and fifth entering the orbit. Total length 354 (296 + 58) mm.

LYCOPHIDION CAPENSE CAPENSE (A. Smith)

♂ (M. C. Z. 50249) Liwale. 16.x.49.

Midbody scale rows 17; ventrals 188; subcaudals 46; labials 7–8, the third, fourth and fifth entering the orbit; throat white. Total length 238 (187 + 51) mm.

Parker, in "The Snakes of Somaliland and the Sokotra Islands" (1949, Zoolog. Verhand., No. 6, p. 55) has recently protested at my practice of designating certain coastal *capense* as intermediates between *capense* and *acutirostre*. It does, however, serve to draw attention to the presence of a coastal population (extending inland as far as Kibwezi in Kenya, Morogoro and Ugano in Tanganyika) characterized by dark throat coupled with low ventral and subcaudal counts. The alternative would be to designate them subspecifically which I am loth to do until we know more about them. Recently I caught our eighteenth example of this kind, viz:

♂ (M. C. Z. 50289) Mgulani near Dar es Salaam. 13.vii.48.

It has midbody scale rows 17; ventrals 165; subcaudals 34; labials 8, the third, fourth and fifth entering the orbit; throat plumbeous. Total length 329 (283 + 46) mm.

Parker (1949, p. 55, footnote) points out there are good reasons for doubting that the type of *acutirostre* Günther, which Sir John Kirk sent from Zanzibar, ever came from the island. He apparently thinks it came from the mainland, may be from Mozambique. Mozambique, in the *restricted* sense used by Kirk may, I think, be ruled out for I know of no record of its having been taken there before or since. I found none during the five months I spent at Lumbo on the mainland directly opposite Mozambique Island, where *L. semiannulis* was the only wolf snake encountered. The few records from Mozambique in its modern sense of Portuguese East Africa are all from much further south.

Of sixty *capense* examined by Parker the only one approaching the low ventral and subcaudal count of the type of *acutirostre* came from Kosi Bay, Zululand.

MEHELYA CAPENSIS CAPENSIS (A. Smith)

1 (M. C. Z. 50070) Ruponda, Lindi District. 8.ii.48.

Ventrals 220; tail truncated. The stomach held a large lizard (*Gerrhosaurus n. nigrolineatus*).

CHLOROPHIS is a synonym of PHILOTHAMNUS

Ever since Flower (1933) pointed out that keels might be present or absent on the ventrals of *irregularis*, data have been accumulating to show that this is also the case with other members of the genus *Chlorophis* as recognized by Boulenger (1894). A genus that — since Bogert's (1940, Bull. Am. Mus. Nat. Hist., **77**, pp. 51–57) studies showed there was no essential difference in dentition or hemipeneal characters — was allegedly separable from *Philothamnus* only by the presence or absence of keels on the subcaudals.

Comprehensive revisionary studies, which cannot be published at present, reveal that the subcaudals in both *irregularis* and *heterolepidotus* may be so sharply angular, and occasionally sufficiently notched, to have misled workers from before Boulenger[1] to the present day into referring them to *semivariegatus*, type of the genus *Philothamnus*. Conversely, in at least one race of *semivariegatus* (*dorsalis*) the subcaudals may be no more keeled than in certain *irregularis*. Though they are so sharply keeled in typical *semivariegatus* it seems advisable to relegate *Chlorophis* to the synonymy of *Philothamnus*, an action with which Mr. C. M. Bogert concurs.

Bogert (1940, p. 54) commenced clarifying the situation so far as eastern Africa was concerned, by pointing out that *neglectus* (Peters, 1866) was a straight synonym of *hoplogaster* (Günther, 1863). Not only were both species recognized by Boulenger (1894, Cat. Snakes Brit. Mus., **2**, p. 92) — on whose key all subsequent ones have been based — but his descriptions of *both* were composites of *hoplogaster* plus a more northerly unnamed form.

That two species or races were involved I felt sure, for in size the Uganda-Kenya reptiles far surpassed the central and southern Tanganyika snakes with which I was also familiar. Decision on the matter had to be deferred until such time as I could thoroughly revise the entire genus. Meanwhile, attaching importance to the common character of two labials entering the eye, I assumed we should find a southern and northern form separable only by subcaudal counts of the respective sexes.

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[1] The Ugogo snake referred to *Chlorophis irregularis* by Boulenger (1894, p. 97) proves to be a *Philothamnus semivariegatus* with a single anterior temporal, so Parker and Battersby inform me.

This supposition received a setback when Parker (1949, Zool. Verhand. Rijksmuseum Natuur. Hist. Leiden, No. 6, p. 61) suggested that the northeasterly snake was nothing but a race of *irregularis*. A generic study, based on the abundant material in the Museum of Comparative Zoölogy and elsewhere, proves Parker to be correct, for in range of ventrals and subcaudals *irregularis* and the northeasterly snake are indistinguishable, being separable only on the labial character as set forth in the diagnosis below.

Unfortunately Parker applied the name "*hoplogaster*" to this northeasterly form, from which *hoplogaster* is undoubtedly an offshoot. That *hoplogaster* cannot be regarded as yet another race of *irregularis* is clear, for in Nyasaland I found both occurring together in many places, yet readily separable by differences in subcaudal counts which were constantly correlated with the labial differences mentioned in the diagnosis.

In seeking a name for this northeasterly population, which in the matter of its labials is almost 100% pure (for the allegedly Ethiopian *irregularis* mentioned by Parker, though sent me in 1930 as having been taken at "Metemma, Ethiopia," was more probably purchased from an itinerant snake vendor at Metemma on the Nile during Dr. W. H. Osgood's homeward journey), I had to reject *angolensis* (Bocage, 1882), subsequently synonymized with *irregularis* by its author. For though indistinguishable from snakes of the northeasterly population, it was based on an aberrant *irregularis* within whose western range such aberrant individuals occasionally occur, though so infrequently as not to form more than 5% of the population.

The opportunity is taken of thanking Mr. C. J. Battersby (after whom I take pleasure in naming the new form) for his kindness in checking the sex, scale counts, or history of much *Chlorophis* material in the British Museum. I am also indebted to Dr. D. Cochran (United States National Museum) and Mr. C. H. Pope (Chicago Natural History Museum) for the loan of specimens designated as paratypes below.

PHILOTHAMNUS IRREGULARIS BATTERSBYI subsp. nov.

Type. Museum of Comparative Zoölogy, No. 40155, an adult ♀ from Sipi Forest at 6,000 feet, Mount Elgon, eastern Uganda. One of 22 collected there by Arthur Loveridge between December 12–23, 1933.

Paratypes. Thirty-nine ♂♂ and seventy-seven ♀♀, viz.: C.N.H.M Nos. 2256–7, 2260, 2263, 2265–6, 2270. M.C.Z. Nos. 13661, 23220–32, 23251, 29425, 30131, 34918–9, 40151–4, 40156–71, 40484–509, 40515–21, 48277. U.S.N.M. Nos. 40766–7, 40953–8, 40984–5, 40988, 40999, 41135, 41512–3, 41693, 41701, 41970, 41978, 42048, 42063–4, 42256, 42935–6, 48588, 49003, 49007, 49012, 49021, and 120814.

These are from: UGANDA: Mt. Debasien; Mt. Elgon — Butandiga — Sipi; Mubango, Mabira Forest. KENYA COLONY: Athi River; Fort Hall; Juja Farm; Kaimosi; Kau; Kenya Province; Kijabe; Kirui's Village; Lake Elementeita; Lake Naivasha; Lake Peccatoni; Mkonumbi; Mtito Andei; Nairobi; Ngatana; Voi; Wambugu. TANGANYIKA TERRITORY: Korogwe; Lake Victoria — Ukerewe Id.; Usambara Mts. — Amani — Bumbuli — Mlalo.

Diagnosis. From typical *irregularis* separable only on upper labials, viz.:

Two labials (rarely the 3rd and 4th, normally the 4th and 5th, occasionally the 5th and 6th) entering the orbit in all northeasterly material. . *i. battersbyi*

Usually three labials (rarely 3rd, 4th and 5th, normally 4th, 5th and 6th, rarely 5th, 6th and 7th) but occasionally (chiefly among Angolan snakes and not more than 5% of the West African population) only two labials (the 4th and 5th, or 5th and 6th) entering the orbit. . . . . *i. irregularis*

From *hoplogaster*, with which it has heretofore been confused, by

Subcaudals in ♀♀ 77–90, in ♂♂ 88–106; range: East Africa from the Usambara Mountains south through the Rhodesias to Natal. . *hoplogaster*

Subcaudals in ♀♀ 90–111, in ♂♂ 100–120; range: East Africa in the Usambara Mountains north through Kenya to Ethiopia, west to the Nile and Uganda where it merges with typical *irregularis*. . . . . *i. battersbyi*

Description. (Paratype variations in parentheses). Preocular 1 (rarely 2); postoculars 2 (rarely 3); temporals 1 + 1 (right) and 1 + 2 (left; 2 + 2 on one side of a Butandiga snake only); upper labials 8 (7–9), the fourth and fifth (rarely third and fourth or fifth and sixth) entering the orbit; lower labials 11 (8–11), the first 5 (4–6) in contact with the anterior sublinguals; midbody scale rows 15; ventrals 173 (♂♂ 147–169; ♀♀ 156–177); anal divided (rarely entire; in a Naivasha snake: U.S.N.M. 41701 only); subcaudals 98 (♂♂ 100–120; ♀♀ 90–111).

Size. Length of holotype ♀ (M.C.Z. 40155), 1045 (762 + 283) mm.; of paratype ♂ (M.C.Z. 40172), 841 (588 + 253) mm.; both from Sipi.

PHILOTHAMNUS SEMIVARIEGATUS SEMIVARIEGATUS (A. Smith)

♀ (M. C. Z. 51290) Liwale. 27.xi.49.

Midbody scale-rows 15; ventrals 187; subcaudals 148; labials 9, the fourth, fifth and sixth entering the orbit; temporals 2 + 2. Total length 707 (454 + 253) mm.

PROSYMNA AMBIGUA STUHLMANNI (Pfeffer)

♂ ♀ (M. C. Z. 51310–1) Liwale. 15–30.x.49.

Midbody scale-rows 15; ventrals 137–147; subcaudals 23–32; postoculars in ♂, 2 on either side, in ♀, 0 and 1, having on the right side been completely fused with the supraocular. Both are of average length.

TARBOPHIS SEMIANNULATUS SEMIANNULATUS (A. Smith)

♀ (M.C.Z. 51293) Liwale. 20.xi.49.

Midbody scale-rows 19; ventrals 229; subcaudals 169; labials 8–9, the third, fourth and fifth (left), or fourth and fifth (right), entering the orbit. Total length 850 (715 + 135) mm.

CROTAPHOPELTIS HOTAMBOEIA HOTAMBOEIA (Laurenti)

♂♂♂ (M. C. Z. 50250) Liwale. 17.x; 20.xi; 13.xii.49.

Midbody scale-rows 19; ventrals 150–157; subcaudals 41–43; preocular 1; postoculars 2. Total length of largest ♂, 482 (411 + 71) mm.

HEMIRHAGERRHIS NOTOTAENIA NOTOTAENIA (Günther)

♀ ♀ (M. C. Z. 51291–2) Liwale. 24–27.xi.49.

Midbody scale-rows 17; ventrals 173–177; subcaudals 73 (both); temporals 1 + 2. Neither large.

PSAMMOPHIS SUBTAENIATUS SUDANENSIS Werner

♀ (Ionides 1644) Liwale. 27.xi.49.

Midbody scale-rows 19; ventrals 229; tail incomplete, but undoubtedly referable to this northern race as defined on pp. 50–55 of the generic revision (Loveridge, 1940d, Bull. Mus. Comp. Zoöl., 87, pp. 1–70).

AMBLYODIPSAS KATANGENSIS IONIDESI subsp. nov.

Type. Museum of Comparative Zoölogy, No. 51364, a gravid ♀ from Tunduru, Southern Province, Tanganyika Territory. Collected by C. J. P. Ionides, Esq., January 21, 1950.

Paratypes. Museum of Comparative Zoölogy, Nos. 50072–4, 51365–7, consisting of two adult ♂♂, an adult and an immature ♀, and two skulls (removed from shrivelled ♀♀, discarded after data had been removed from them) all from Liwale, Southern Province, and taken on 3.v.49, 2.iv.50, 19.iv.50 and 1.v.50. Also three specimens in the British Museum (bearing Ionides numbers 60, 194, 387, and taken by him on 20.iii.48, 27.vi.48, and 23.iv,49 respectively), being a ♀ and ♂ from Liwale and a ♀ from Tunduru District, Southern Province, Tanganyika Territory.

Diagnosis. These ten snakes differ from the typical form described by Witte and Laurent from a single pair taken at Katanga, Congo Belge (*ca.* 700 miles due west of Liwale), in possessing a smaller supraocular that is one-fifth (instead of one-fourth) the width of the frontal; in the smaller eye which is included 2 or 3 (instead of 1¾) times in its distance from the labial border; in possessing only 4 labials (the scale called a fifth by Witte and Laurent being fused with the large temporal); and in the lower range of ventrals (166–198 instead of 179–207) and subcaudals (14–24 instead of 19–26).

Description. (Paratype variations in parentheses). Snout rounded, projecting far beyond the lower jaw; rostral twice as broad as deep, concave below, the portion visible from above much more than half its distance from the frontal; prefrontal 1¼ (1⅓ to 1¾) times as long as broad; frontal large, slightly longer than broad, 5 times as broad as a supraocular, 1⅓ (1⅛ to 1½) times its distance from end of snout, scarcely shorter than the parietals; supraocular very small; eye very small, its diameter included 3 times in its distance from the mouth; postocular absent (absent on 9 sides, present on 9 sides); temporal 1; upper labials 4, second in contact with the prefrontal, second and third entering the orbit, fourth largest and in contact with the parietal; lower labials 5, the first pair in contact behind the mental, anterior three in contact with the sublinguals; no posterior sublinguals. Midbody scales in 15 rows; ventrals 196 (♂♂ 166–172, ♀♀ 182–198); anal divided; subcaudals 18 pairs (♂♂ 22–24, ♀♀ 14–17).

Color. Above and below iridescent plumbeous black, uniform (M. C. Z. 50072-4) or chin and/or circumanal area white (Ionides Nos. 60, 387), or chin to anus mottled with ivory white, the patches sometimes covering three or four ventrals (Ionides No. 194) suggesting sexual dichromatism as present in two of the three males.

Size. Total length of holotype ♀ (M. C. Z. 51364), 298 (280 + 18) mm.; largest adult paratype ♂ (B. M. 1948.1.8.12), 304 (278 + 26) mm.; a larger adult ♀ (B. M. 1948.1.8.13), 320 (302 + 18) mm. An even larger ♀ (M. C. Z. 50074, now a skull) measured 346 (326 + 20) mm., dimensions that compare well with those of the paratype ♀ of *A. k. katangensis* recorded by Witte and Laurent as being 344 (323 + 21) mm.

Remarks. Named after its discoverer, C. J. P. Ionides, Esq., who is to be congratulated on being the first to find this genus in Tanganyika Territory. The sixteen specimens he has found to date have been donated by him to four different museums.

Key to the Species of the Genus CHILORHINOPHIS

1. Nasal shield distinct from first labial; prefrontal separated from orbit by preocular; frontal about 1½ times as long as broad .... 2.

   Nasal shield fused with first labial to form a single nasolabial shield[1]; prefrontal either entering orbit or separated from it by preocular; frontal only slightly longer than broad .... 3.

2. Ventrals in ♂♂ 308–310, in ♀ 375; subcaudals in ♂♂ 25–26, in ♀ 23; tail included 17.8–18.6 times in total length of ♂♂, 23.6 times in ♀; maximum recorded length of ♂ 486 mm., of ♀ 569 mm.; range: western Tanganyika Territory (Ujiji) south to Northern Rhodesia (Nyamkolo), west to southern Belgian Congo (Lukonzolwa, Lake Mweru) ....
g. tanganyikae subsp. nov.

   Ventrals in ♂♂ 263–294, in ♀♀ 274–348; subcaudals in ♂♂ 27–31, in ♀♀ 20–26; tail included 12.3–15.2 times in total length of ♂♂, 16.2–21.2 times in ♀♀; maximum recorded length of ♂ 424 mm., of ♀ 513 mm.; southern Belgian Congo south to Southern Rhodesia ....
g. gerardi (Boulenger)

3. One pair of sublinguals; ventrals in supposed ♀ holotype 256; subcaudals 33; tail included 15.7 times in total length of ♀; length of only known and unsexed specimen 315 mm.; range: Anglo-Egyptian Sudan (Mongalla) . .
butleri Werner

   Two pairs of sublinguals; ventrals in ♂♂ (unknown for *c. carpenteri*) 210–238, in ♀♀ 216–288; tail included 10.6–12.7 times in *c. liwalensis* ♂♂, 14.4–19.6 in ♀♀ (both races); maximum recorded length in *c. liwalensis* ♂♂ 300 mm., of ♀♀ 335 mm. .... 4.

4. Three longitudinal dark stripes on back and sides; range: southeastern Tanganyika Territory (3 or 4 localities) .... *c. liwalensis* subsp. nov.

   Five longitudinal dark stripes on back and sides; range: eastern Mozambique (Ancuabe, about 30 miles west of Porto Amelia) ....
c. carpenteri (Parker)

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[1] Not fused on right side only of M. C. Z. 51328, a ♀ from Liwale but the only one of about fifty paratypes to show such a reversion to the ancestral arrangement.

CHILORHINOPHIS GERARDI TANGANYIKAE subsp. nov.

Chilorhinophis gerardi Loveridge (part), 1933, Bull. Mus. Comp. Zoöl., **74**, p. 262: Nyamkolo, Northern Rhodesia.

Type. Museum of Comparative Zoölogy, No. 30402, an adult ♂ with extruded hemipenes from Nyamkolo, Lake Tanganyika, Northern Rhodesia. Collected by Arthur Loveridge, May 9th, 1930.

Paratypes. Museum of Comparative Zoölogy, No. 48434, an adult ♂ with extruded hemipenes from Ujiji, Lake Tanganyika, Tanganyika Territory. Collected by Arthur Loveridge, March 11th, 1939. Also Inst. Royal Sci. Nat. Belgique, No. I. G. 15824, an adult ♀ from Lukonzolwa, Lake Mweru, Belgian Congo. Collected by Ach. Rév. Père Cornet in 1940.

Diagnosis. Differs only from the typical western form in having more numerous ventrals (308–310 instead of 263–294 in ♂♂; 375 instead of 274–348 in ♀♀); fewer subcaudals (25–26 instead of 27–31 in ♂♂); relatively shorter tails (17.8–18.6 instead of 12.3–15.2 times in total length of ♂♂; 23.6 instead of 16.2–21.2 times in total length of ♀♀). In fact these unquestionable ♂♂ of *tanganyikae*, instead of presenting the characters and proportions of the seven known ♂♂ of typical *gerardi*, possess those of *gerardi* ♀♀.

Description. (Paratype variations in parentheses). Rostral twice as broad as deep, the portion visible from above as long as one third its distance from the frontal; nostril in a single nasal that is *not* fused with the first labial; prefrontals longer than broad, not entering the orbit; frontal longer than its distance from the rostral, 1½ (—1⅓) times as long as broad, 1¼ (1$^4/_5$–2) times as broad as a supraocular, its length included 1½ (—1¾) times in that of a parietal; preocular 1, moderate; eye small, its diameter two-thirds its distance from the lip; postocular 1, moderate; a large (or moderate) posterior temporal in contact with the posterior border of the parietal; upper labials 4, second in contact with the prefrontal, third entering the orbit, fourth largest and in contact with the parietal; lower labials 5, the first broadly in contact with its fellow behind the mental, 3 labials in contact with the anterior sublinguals, which are divergent and longer than the posterior. Midbody scales in 15 rows, smooth; ventrals 308 (—310) in ♂♂ (375 in ♀); anal divided; subcaudals (25—) 26 in ♂♂ (23 in ♀).

Color in alcohol. Above, head and neck black, the black descending on the sides of the neck suggesting a collar; labials yellow with black spots on rostral, beneath eye, and near gape; prefrontals, parietals and nape each bearing two small white spots; back yellowish-white with a dark-brown vertebral stripe flanked by a dark-brown dorsolateral stripe on the fifth, and adjacent halves of the fourth and sixth, scale-rows, the three stripes extending almost to the tip of the tail; the three lower lateral scale-rows uniform white; posterior third of tail black with light flecking. Below, throat and belly immaculate yellowish-white, a black crossband on posterior third of tail whose tip is also black. (For color in life *cf. cit. supra*).

Size. Length of holotype ♂ (M. C. Z. 30402), 445 (420 + 25) mm., surpassed by that of the paratype ♂ which is 486 (460 + 26) mm., and paratype ♀ (I. G. 15.824) of 569 (545 + 24) mm. Diameters of ♂♂ 4.5–5 mm., of ♀ about 3.5 mm. For relative proportions see *Diagnosis* above.

Remarks. The Ujiji paratype, the first *authentic* example of a *Chilorhinophis* to be taken in Tanganyika Territory, was inadvertently omitted from the report of the reptiles collected during my 1938–1939 expedition (1942e, Bull. Mus. Comp. Zoöl., **91**, pp. 235–436). For, noting the differences between it and all recorded Congo males, I put it aside intending to make further enquiries of Dr. Gaston de Witte respecting the sexing of Congo material. Events occurring at that time made it necessary to postpone the matter and only recently has it been possible for Dr. de Witte to supply me with additional data (in litt.), embodied in the accompanying key to members of the genus, and very generously place at my disposal the only known female of the new race.

I repeat that this is the first authentic taking of a Tanganyika *Chilorhinophis*, for Sternfeld's (1910) listing of the Sudanese *butleri* as occurring at Amani in the Usambara Mountains may well be based on a carelessly identified *Aparallactus werneri*, to which species it bears a superficial resemblance. However that may be, the specimen has been missing from the Berlin Museum for a quarter-century. Pitman's not unnatural conclusion (1937, Uganda Journal, p. 329) that this Amani snake formed the basis of Sternfeld's description and dimensions, is incorrect, for it is a synopsis of Werner's original account with the measurements in round figures. Most of Sternfeld's descriptions in this and other contributions to the series are brief German translations of the longer ones in Boulenger's catalogues, with Boulenger's measurements changed to centimetres — later given in inches by Pitman under the impression that they represented original measurements made by Sternfeld.

CHILORHINOPHIS CARPENTERI LIWALENSIS subsp. nov.

Type. Museum of Comparative Zoölogy, No. 50076, an adult ♀ from Liwale, 2,100 feet, 9° 45′ S., 37° 55′ E., Southern Province, Tanganyika Territory. Collected by C. J. P. Ionides, Esq., March 30th, 1948.

Paratypes. Museum of Comparative Zoölogy, Nos. 50077–89, 51327–8, together with twenty-two Liwale specimens in the British Museum (N. H.) and sixteen uncatalogued duplicates in the M. C. Z. taken between March 30, 1948 and March 13, 1950. Also M. C. Z. 50075 from Masasi District, and M. C. Z. 50090 from Ruponda, Lindi District; all in the Southern Province of Tanganyika Territory, and collected by Mr. C. J. P. Ionides.

Diagnosis. Distinguished from the typical form as follows:

Three longitudinal stripes on back and sides; ventrals in females 216–270[1], in males 210–238; range: southeastern Tanganyika Territory. . . *c. liwalensis*
Five longitudinal stripes on back and sides; ventrals in female 269, male unknown; range: northeastern Mozambique (known only from Ancuabe, 13° 02′ S., 39° 55′ E.) . . . . *c. carpenteri*

Description. (Paratype variations in parentheses). Rostral nearly twice as broad as deep, the portion visible from above as long as half its distance from the frontal; nostril in a single nasal that is fused with the first labial (except on right side only of M. C. Z. 51328) and so reaches the lip; prefrontals longer than broad, not entering the orbit (not entering in 21 paratypes, entering in 30 paratypes, both conditions in 4); frontal shorter than its distance from the rostral, slightly longer than broad, about twice as broad as a supraocular, much shorter than a parietal; preocular 1, moderate (or minute in specimens where the prefrontal enters orbit); eye small, its diameter about two-thirds its distance from the mouth; postocular 1; a large upper temporal bordering the parietal; upper labials 4 (reckoning the nasolabial as the first), second in contact with the prefrontal, third entering the orbit, fourth largest and broadly in contact with the parietal; lower labials 5, the first broadly in contact with its fellow behind the mental, 3 (4 on right side of M. C. Z. 50081) labials in contact with the anterior sublinguals, which are divergent and longer than the posterior. Midbody scales in 15 rows, smooth; ventrals 253 (217-238 in male paratypes, 216–270 in female paratypes); anal divided; subcaudals 20 (25-30 in males, 18–24 in females).

Color in alcohol. Above, head and neck black, the latter descending on the sides of the neck suggesting a collar; labials yellow; (the temporal scale exhibits a white spot in some paratypes); back yellowish-white with a broad brown vertebral stripe on the vertebral scale and adjacent half-scales; a dark dorsolateral stripe on the adjacent halves of the fifth and sixth scale-rows (in M. C. Z. 50090 only the lower lateral scales are faintly edged with brown); posterior half of tail black except for some blue-gray mottling about the tip. Below, chin with (or without) dusky markings; otherwise throat and belly immaculate yellowish-white; basal half of tail white, separated by a black bar from a blue-gray area near the tip. Ionides writes: "Colour in life varies from light yellow to khaki."

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[1] If the coastal specimen (B. M. coll.) from Kilwa, 125 miles northeast of Liwale, be included, this figure should be raised to 288 (count checked by me) which would give a ventral range of 73 for female *liwalensis*, comparable to the 74 displayed by female *g. gerardi*. On the other hand additional Kilwa material may demonstrate the presence of a coastal form averaging a higher number of ventrals.

Size. Total length of holotype ♀ (M. C. Z. 50076), 335 (315 + 20) mm., of a paratype ♂ (M. C. Z. 51327), 300 (274 + 26) mm. For the entire series the tail length is included in the total length 10.6 to 12.7 times in ♂♂, 14.4 to 19.6 times in ♀♀. Midbody diameter of ♀ type, 3.5 mm.

Remarks. Battersby (1950, pp. 416–417) considers these Liwale specimens should be referred to *C. butleri* Werner, of Mongalla, Anglo-Egyptian Sudan (1,500 miles distant from Liwale by arrow-flight), suggesting that the single pair of chin shields of the unsexed holotype might be the result of fusion. With this action I cannot concur, for every one of the more than 50 Liwale specimens exhibit two pairs; moreover, if the type of *butleri* is a male it differs from 25 Liwale males in its more numerous ventrals and subcaudals and shorter tail; if on the other hand it is a ♀, as I suspect, it differs from 25 Liwale females in having 33 instead of 18–24 subcaudals.

Similarly, as three well-defined dark lines are present on the back and sides of *butleri* and all Tanganyika material, the synonymizing of the Mozambique holotype of *carpenteri* (Parker), which has five such lines, should be postponed until more material of the extreme southeasterly form is available for study.

Native name. Kitandamba (Ngindo) i.e. the one found among *ndandamba* beans, loosely applied to snakes of related genera such as *Aparallactus*, etc.

Habits. Ionides informs me that: "*Chilorhinophis*, like adult *Typhlops*, apparently remains underground except after heavy rain."

Diet. From the stomach of one I recovered an adult *Amphisbaena ionidesii* Battersby.

CALAMELAPS UNICOLOR WARRENI Boulenger

♂♂ (M. C. Z. 50071, 51309) Liwale. 30.i.48; 15–30.x.49.

Midbody scale-rows 19; ventrals 167–168; subcaudals 27–28, of which the first six are single in M. C. Z. 50071. Total length of larger

♂, 388 (374 + 14) mm. In its stomach is a juvenile blind snake (*Typhlops s. mucruso*); an exceptionally large blind snake of the same species was in process of being swallowed by another *warreni* which Mr. Ionides reports as measuring "thirty-two-and-a-half inches."

APARALLACTUS LUNULATUS LUNULATUS (Peters)

♀ (M. C. Z. 50091) Masasi District. 15.i.48.
juv. ♂ (M. C. Z. 50092) Liwale. 4.v.49.

Midbody scale-rows 15; ventrals 157–164; anal 1; subcaudals 51–55; labials 6, the third and fourth entering the orbit; nasal in contact with preocular. Total length of ♀, 420 (343 + 77) mm. Her stomach held a huge centipede.

Color of juvenile ♂. Above, crown black; nuchal collar five scales in width, black, edged with white before and behind; anterior part of back with a series of white-edged black spots diminishing in size posteriorly, the posterior part of back and tail purplish-black. Below, throat and anterior portion of body white, posteriorly grayish.

Color of adult ♀. Above, uniform purplish-black. Below, throat, posterior edges of ventrals and much of tail whitish, otherwise black. To what extent this melanism is an indication of maturity, as in *Elapsoidea*, is worth investigating.

Witte & Laurent (1947, Mem. Mus. Royal Hist. Nat. Belgique (2), No. 29, p. 110) synonymize *concolor* with *lunulatus* but later (p. 113) state that this is only provisional and proceed to use trinomials. There is abundant material to justify the retention of *concolor* as a northern race characterized by a nasal that is not in contact with the preocular.

APARALLACTUS ? WERNERI Boulenger

♂ (M. C. Z. 50093) Liwale. ix.48.

Midbody scale-rows 15; ventrals 144; anal 1; subcaudals 40; labials 5, second and third entering orbit, fourth and fifth separated from parietal; first lower labial broadly in contact with its fellow behind the mental. Total length 189 (157 + 32) mm.

Though this snake exhibits all the characters of *werneri*, in coloring and size it resembles *capensis* from the same locality so closely that one wonders if there is not a closer relationship.

APARALLACTUS CAPENSIS CAPENSIS A. Smith

♀ (M. C. Z. 50094) Liwale. 16.ix.48.

Midbody scale-rows 15; ventrals 153; anal 1; subcaudals 42; labials 6, third and fourth entering orbit, fifth in contact with parietal; first lower labial widely separated from its fellow behind the mental. Total length 210 (174 + 36) mm. See note under *werneri* above.

ELAPSOIDEA SUNDEVALLII DECOSTERI Boulenger

Native name. Njoka ishanga (Ngindo) i.e. 'necklace snake.'

Mr. Ionides comments on the almost entire absence of white on adults of *decosteri,* as is known to be the case with other races of this garter snake. It appears possible that *Aparallactus l. lunulatus* also tends to darken and lose its markings with age.

NAJA NIGRICOLLIS NIGRICOLLIS Reinhardt

Native name. Nachiku (Ngindo).

Mr. Ionides, who is familiar with *N. melanoleuca,* reports catching a "♀ *nigricollis,* 6 feet 5¾ inches in length. She was about to cross a main road but on seeing me, stopped, turned her head slightly in my direction and, without further movement, allowed me to walk slowly up to her and slip a noose over her slightly raised head. Even after being noosed she scarcely struggled. She appeared to have sloughed recently and was very thick and heavy, being full of fat though her stomach was empty." The incident apparently occurred in March as Mr. Ionides wrote me on 2.iv.1948. He found another of these spitting cobras about to eat "a freshly killed *Rhamphiophis o. rostratus.*"

DENDROASPIS ANGUSTICEPS (A. Smith)

♀ (M. C. Z. 51313) Liwale. 15–30.x.49.

Native name. Namahamba (Ngindo) i.e. 'green one,' but applied also to *Chlorophis, Philothamnus* & *Dispholidus.*

Midbody scale-rows 19; ventrals 223; subcaudals 124. Total length only 716 (545 + 171) mm. At Mr. Ionides' request, the Director of the Coryndon Memorial Museum kindly forwarded me one of the "brilliant emerald green" mambas from Liwale that were identified as *D. jamesonii* by Professor Toschi. As suspected, it proved to be a common mamba.

Mr. Ionides informs me that he has taken several young of what he believes to be this species, of a lightish, sometimes faintly barred, rather dull green. The adults appear to be always a bright emerald hue, he says, resembling the green phase of the boomslang. Snakes of this type he has seen in the Liwale, Lindi, and Kilwa Districts, none of them exceeding six and a half feet in length.

DENDROASPIS POLYLEPIS Günther

♂ (Brit. Mus.) Liwale Boma. 11.iv.49.

Native name. Ndemalunyayo (Ngindo), i.e. 'grass cutter' from its alleged habit of clipping grass.

Mr. Ionides writes that this snake, sent alive by him to the London Zoological Gardens, was subsequently identified as *polylepis* by Dr. H. W. Parker, who reported it as having: Ventrals 258; subcaudals 108. Colour brown. Length 6 feet, 9 inches. Ionides adds that he presumes juvenile mambas of a dull olive shade are the young of the "black mamba." Two slender, six-foot specimens were almost a "bluish tinge, darker on the back," while the biggest examples were usually "darkish olive, chocolate brown, or gunmetal color". Snakes of this type he believes he has seen in the Kilwa, Liwale, Lindi, Masasi, and Tunduru Districts. In some instances he noted that the lining of the mouth was black but, not realizing its diagnostic significance, did not examine every specimen.

However, none of the mambas he caught displayed the aggressive disposition with which this species is credited further south. In illustration of this Mr. Ionides wrote on July 3, 1949, of dislodging one large mamba from the thatch of a granary by hooking the grass, and finally the snake, off with a pole. The reptile was then pinned to the ground and picked up to be sent to the London Zoo. After other means had failed to dislodge her, a second snake was pelted with small sticks until she came down from a mango tree. She too was then held down by a stick until seized. A third mamba, between six and seven feet in length, entered a fish trap that had been hung in a tree. Some very small fish, called by the natives *dagaa,* had been left in the trap, but whether they exerted any attraction for the snake was uncertain.

BITIS ARIETANS (Merrem)

Native name. Boma, liboma, lipiri, kipiri (Ngindo for color phases or size differences).

Writing on July 15, 1948, Mr. Ionides remarks that he had recently witnessed a pair of puff adders courting; so far as he could see no copulation took place. With heads close together and raised very high, the two vipers turned from side to side, the supposed male occasionally intertwining his body with that of the female; from time to time he slid his head over her neck in a caressing manner. The courtship was interrupted after ten minutes by the reptiles realizing Ionides' presence. After subjecting him to prolonged scrutiny, they made off at a rate much faster than is normal for these heavy bodied snakes. Both seemed to have sloughed recently and appeared very alert and active.

ATRACTASPIS BIBRONII A. Smith

♀ (M. C. Z. 50095) Ruponda, Lindi District. 9.i.48.
7 ♂♂ 8 ♀♀ (M. C. Z. 50096–9, 50251–60, 51312) Liwale District. 1948–9.
1 ♂ 3 ♀♀ (M. C. Z. 50261–4) Lindi District. 1948–1949.
1 ♂ 4 ♀♀ (M. C. Z. 50265–9) Kilwa District. 1948–1949.

Midbody scale-rows 21–25; ventrals 210–238; anal entire; subcaudals 19–25; labials 5, third and fourth entering the orbit; first lower labial broadly or narrowly in contact with its fellow behind the mental. Total length of largest ♂ (M. C. Z. 51312), 601 (563 + 38) mm., and ♀ (M. C. Z. 50263), 598 (569 + 29) mm.

A. katangae Boulenger, which I (1942e. Bull. Mus. Comp. Zoöl., **91**, p. 316) synonymized with *bibronii*, was revived as a race of that species by Laurent (1945. Revue Zool. Bot. Afr., **38**, p. 335), who now agrees that it is untenable. In the same paper he suggests that *rostrata* Günther, synonymized with *bibronii* by Peters in 1882, should also be revived as a race of *bibronii* for tropical African snakes. While this may have to be done, such action at the present time appears premature in the absence of statistical evidence that a preponderating majority of South African snakes have only 21 midbody scale-rows. So far as Tanganyika snakes are concerned the proportion with 23 rows is below the 75% required by Dunn's law. Of the forty-one Tanganyika snakes I have counted, seven have 21 rows, four have 22 rows, twenty-nine have 23 rows, and one has 25 rows. The type locality of *rostrata* was given as Zanzibar.

In one large ♀ is a full-grown *Amphisbaena ionidesii,* and Ionides tells me that a 14⅝-inch ♀ not only had an entirely undigested 9¾-inch *Crotaphopeltis h. hotamboeia* in its stomach, but a 7⅛-inch *Causus defilippi* in its gullet with the night adder's tail protruding from the mouth of its captor.

BUFO CARENS A. Smith

Skull (M. C. Z. 26649) Southern Province. 1947.

BUFO REGULARIS REGULARIS Reuss

♂ (M. C. Z. 26627) Liwale. 13.vii.48.
Skull (M. C. Z. 26650) Southern Province.

CHIROMANTIS XERAMPELINA Peters

♀ (M. C. Z. 26628) Lindi District. 20.xii.47.
♀ (M. C. Z. 26629) Liwale. 12.vii.48.

LEPTOPELIS ARGENTEUS (Pfeffer)

Hylambates argenteus Pfeffer, 1892, Jahrb. Hamburg Wiss. Anst., **10**, p. 100, pl. ii, fig. 3: Marsh south of Bagamoyo, Tanganyika Territory.

1 (M. C. Z. 26632) Ruponda, Lindi District. 8.i.48.

On seeing this shrivelled, 38 mm.-long frog with a dorso-lateral and lateral stripe on either side, I was immediately reminded of Pfeffer's figure of the similarly dried out type of *argenteus*. A species that Ernst Ahl (1931, Das Tierreich, No. 55, p. 217, fig. 117) correctly referred to *Leptopelis* where it would appear to be related to *L. concolor* and *L. johnstoni*.

HYLAMBATES MACULATUS Duméril

2 (M. C. Z. 26630–1) Liwale. 13.vii.48.

KASSINA SENEGALENSIS (Duméril & Bibron)

♀ (M. C. Z. 26633) Lindi District. 28.xii.47.

A gravid, but shrivelled specimen of 37 mm. Several races of *senegalensis* have been described.

MEGALIXALUS FORNASINII FORNASINII (Bianconi)

♂ (M. C. Z. 26634) Liwale District. 24.i.48.

MEGALIXALUS BRACHYCNEMIS Boulenger

♀ (M. C. Z. 26635) Liwale District. 24.i.48.

HYPEROLIUS sp.

♂ ♀ (M. C. Z. 26636–7) Liwale District. 24.i.48.

RANA ADSPERSA EDULIS (Peters)

1 & skull (M. C. Z. 26638–9) Lindi District. 5 & 19.xii.47.

RANA ORNATA ORNATA (Peters)

1 (M. C. Z. 26640) Lindi District. xii.47.

After comparison of this 56 mm. frog with three others of the species from Tanganyika Territory and the Belgian Congo, trinomials are used as *ruddi* Boulenger (1907, Proc. Zool. Soc. London, pp. 480–481, pl. xxii, figs. 1–1b) of Beira, is undoubtedly a subspecies, apparently differing only in the less extensive webbing between its toes.

RANA OXYRHYNCHUS OXYRHYNCHUS A. Smith

2 (M. C. Z. 26641) Lindi District. 23.xii.47.

RANA MASCARENIENSIS MASCARENIENSIS Duméril & Bibron

2 (M. C. Z. 26642) Liwale. 8.vii.48.

ARTHROLEPTIS STENODACTYLUS STENODACTYLUS Pfeffer

1 (M. C. Z. 26643) Liwale. 8.vii.48.
1 (M. C. Z. 26644) Masasi District. 20.i.48.

Some doubt attaches to the data of this Masasi frog for the label with it read: "Tree frog No. 35."

HEMISUS MARMORATUM MARMORATUM (Peters)

♂ ♀ (M. C. Z. 26645–6) Liwale. 7.vii.49.

Presumably a breeding pair measuring 25 and 28 mm. respectively.

PHRYNOMERUS BIFASCIATUS (A. Smith)

Skull & 1 (M. C. Z. 26647–8) Liwale. 13.vii.48.

A gravid ♀ was taken on 21.i.48.

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THE OONOPIDAE OF PANAMA

Arthur M. Chickering
Albion College, Albion, Michigan

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
August, 1951

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THE OONOPIDAE OF PANAMA

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No. 5. — *The Oonopidae of Panama*

By Arthur M. Chickering

The Cambridges ('89–'05) had no representatives of this family from Panama and only one species, *Dysderina plena* Cambridge, from all of Central America. Petrunkevitch ('25) described *Oonops reticulatus* from Panama City. Mr. Banks ('29) recorded *Dysderina plena* Cambridge from Mt. Hope and the Canal Zone Biological Area, C. Z., but by error, as shown below. Gertsch ('41) described *Scaphiella barroana* and *S. williamsi* together with *Oonopinus centralis*. This author also reported the presence of *Dysderina plena* Cambridge in the material sent him by E. C. Williams, Jr. who collected intensively from a small area of the surface of the forest floor on the Canal Zone Biological Area; the specific identity of this spider is open to question.

Including my personal collections of 1934, 1936, and 1939 together with valuable additions sent me by Dr. James Zetek of Balboa, C. Z. a considerable amount of material has now accumulated which sheds much light on the oonopid fauna of this highly interesting country. Together with several new records of known species the following, believed to be new to science, have been selected and described in accord with my usual formula: *Dysderina dura* sp. nov.; *D. recondita* sp. nov.; *D. seclusa* sp. nov.; *D. silvatica* sp. nov.; *Oonopinus modestus* sp. nov.; *O. pallidulus* sp. nov.; *Oonopoides bryantae* sp. nov.; *Oonops donaldi* sp. nov.; *O. zeteki* sp. nov.; *Opopaea recondita* sp. nov.; *O. timida* sp. nov.; *Scaphiella gertschi* sp. nov.; *Stenoonops petrunkevitchi* sp. nov.

Monoblemma unica Gertsch, which some might consider an oonopid, is here regarded as properly included in the Tetrablemmidae as originally placed by Dr. Gertsch.

It gives me pleasure again to acknowledge my indebtedness to the following members of the staff of the Museum of Comparative Zoölogy at Harvard College for their continued encouragement and many courtesies for many years: Dr. A. S. Romer, Director; Dr. Joseph C. Bequaert, Head Curator of Recent Insects; Miss Elizabeth B. Bryant, Assistant Curator of Insects; Mr. Ludlow Griscom, Editor of Publications.

Key to Known Genera of Oonopidae of Panama

1. Both dorsal and ventral abdominal scuta present (*Dysderina*, *Opopaea*, males of *Scaphiella*, *Triaeris*) 2

1. With a dorsal scutum or a ventral scutum (not both), or completely lacking scuta (*Ischnothyreus*, *Oonopinus*, *Oonopoides*, *Oonops*, females of *Scaphiella*, *Stenoonops*) 5

2. Legs well supplied with spines (*Dysderina, Triaeris*)..................3
2. Legs without true spines (*Opopaea, Scaphiella* males)..................4
3. Sternum conspicuously grooved; abdomen nearly completely covered by dorsal and ventral scuta..........................*Dysderina*, p. 208
3. Sternum not conspicuously grooved, quite smooth and glabrous; abdomen with a less extensive dorsal scutum and a ventral scutum restricted to anterior half of venter..............................*Triaeris*, p. 243
4. ALE well separated; posterior row of eyes slightly recurved; abdomen definitely depressed dorsoventrally....................*Opopaea*, p. 231
4. ALE barely separated; posterior row of eyes slightly recurved; abdomen definitely not depressed..........................*Scaphiella*, p. 234
5. ALE contiguous; posterior row of eyes procurved; with numerous ventral leg spines; with a small dorsal scutum but lacking a ventral scutum.....
Ischnothyreus, p. 219
5. Not with combination of characters given above....................6
6. ALE well separated; posterior row of eyes recurved; legs without spines; all scuta lacking..7
6. Not with combination of characters given above....................8
7. Posterior row of eyes strongly recurved; maxillae long, slender and strongly convergent..................................*Oonopinus*, p. 220
7. Posterior row of eyes moderately recurved; maxillae also long, slender, convergent but with tips divergent................*Oonopoides*, p. 224
8. ALE barely separated; legs without spines; with a ventral scutum which extends laterally to middorsal line; abdomen laterally compressed.......
Scaphiella (females) p. 234
8. Not with combination of characters given above....................9
9. ALE moderately well separated; lip about as wide as long; legs with numerous spines; scuta lacking.......................*Oonops*, p. 226
9. ALE only slightly separated; lip wider than long; legs without spines; scuta lacking..................................*Stenoonops*, p. 241

Genus DYSDERINA Simon, 1891

DYSDERINA DURA sp. nov.

(Figures 1–3)

Male holotype. Total length 1.92 mm. Carapace .910 mm. long, .733 mm. wide opposite second coxae where it is widest; well rounded along ventral border from opposite palp to posterior margin; .444 mm. tall and, therefore, about .60 as tall as wide; quite evenly arched from PME to beginning of steep posterior declivity opposite third coxae; surface almost completely and finely granulated except on dorsal surface where the area is nearly devoid of granulations; without a longitudinal thoracic groove; numerous short recurved bristles especially conspicuous in the non-granular area; convex as described for *D. recondita* sp. nov. and *D. seclusa* sp. nov.

Eyes. Six in 2 rows; in a moderately compact group; AME lacking; posterior row occupies about thirteen-seventeenths of width of carapace at that level; posterior row gently recurved. Ratio of eyes ALE : PME : PLE = 4.5 : 4.5 : 5. Boundary of ALE irregular; other eyes somewhat oval. Long axis used for measurements unless otherwise stated. ALE separated by about four-ninths of their width, from PLE by a thin line and from PME by about two-ninths of their diameter. PME contiguous along about one-third of their circumference and barely separated from PLE. Posterior row wider than anterior row in ratio of 13 : 10 (Fig. 1). Height of clypeus equal to two-thirds of the diameter of ALE.

Chelicerae. Vertical, essentially parallel (by outer margins); basal segment .27 mm. long; with no basal boss; with a well developed scopula along promargin of obscure fang groove which has a single tooth near medial end (observed in a dissected paratype to avoid injury to holotype). Fang slender and evenly curved.

Maxillae. Moderately long, slender; somewhat convergent anterior to lip; somewhat notched just anterior to insertion of palp which occurs on basal third; longer (exclusive of hook) than wide at notch in ratio of 14 : 5; with well developed scopula along oblique medial margin at apex; apex with a conspicuous slender hook.

Lip. Details of chelicerae, maxillae, and lip taken from a dissected paratype to avoid injury to holotype. Quite strongly chitinized; wider than long in ratio of 2 : 1; somewhat concave just in front of posterior border; bent almost at a right angle about two-thirds from base; anterior border with an irregular row of stiff bristles.

Sternum. Nearly scutiform; almost as wide as long; slightly the widest between second coxae but almost as wide between first coxae; strongly chitinized and more or less intricately grooved; with more or less distinct lobules opposite the coxae; with a distinct chitinous fold passing around ventral half of pedicel; sternal suture distinctly procurved around base of lip; with chitinous bridges passing between coxae; posterior end bluntly rounded and not extended between fourth coxae which are separated by about ten-sevenths of their width. Coxae three and four subglobose; coxae one and two more elongated.

Legs. 4123. Width of first patella at "knee" .0777 mm., tibial index 9. Width of fourth patella at "knee" .0777 mm., tibial index 9. Claws and trichobothria essentially as recorded for *D. seclusa* sp. nov. Length of palpal tarsus does not include embolus and conductor.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.710	.289	.577	.511	.289	2.376
2.	.710	.289	.533	.533	.266	2.331
3.	.555	.230	.380	.522	.222	1.909
4.	.766	.311	.555	.710	.266	2.608
Palp	.200	.111	.150	...	.355	.816

Spines. First leg: femur only prolateral 0–0–0–1–1 (last one might be considered either a bristle or a weak spine, the other 2 recorded for *D. seclusa* sp. nov. and *D. recondita* sp. nov. appear to have been replaced in this species by a pair of bristles (these are here considered prolateral but might be considered to lie on the promargin of the ventral surface); patella 0; tibia only ventral 2–2–2–2–1p–0 (the fifth on the retromargin appears to have been replaced by a bristle); metatarsus only ventral 2–2–1p (third on retromargin appears to have been replaced by a bristle and all are somewhat staggered). Second leg: femur without true spines; patella 0; tibia essentially as in first; metatarsus only ventral 2–2 but with much irregularity in position. Third and fourth legs without spines. Palp: with several long bristles, 2 on prolateral side of tibia may be considered weak spines.

Palp. Essentially as described in *D. seclusa* sp. nov. and *D. recondita* sp. nov. except in respect to tarsal features. Tarsal spines emerge together as a single apophysis about one-fifth from distal end; this process then separates into a more proximal, shorter, black, slender hook extending obliquely distal, and a second hook extending distally as a brownish, more transparent, larger, curved extension (Figs. 2–3).

Abdomen. Ovoid, plainly and considerably separated from the cephalothorax by the strongly chitinized and corrugated pedicel; longer than wide (exclusive of pedicel) in ratio of 10 : 7; widest near middle; spinnerets and anal tubercle as usual in the genus from Panama; dorsal scutum covers entire dorsum except about one-eighth of length at posterior margin; ventral scutum entire, including pedicel and extending posteriorly for a little more than three-fourths of the distance from genital pore to base of anterior spinnerets. Position of reduced colulus not indicated. Openings to book-lungs, tracheal spiracle, and genital pore as recorded for *D. seclusa* sp. nov.

Color in alcohol. Essentially as described for *D. seclusa* sp. nov.

Type locality. Male holotype from C. Z. Biological Area, C. Z., July, 1936; taken while sifting forest litter. Paratype males from: El Valle, R. P., July, 1936; Porto Bello, R. P., Aug., 1936; C. Z. Biological Area, C. Z., June–July, 1934, July, 1936, Oct.-Dec., 1941 (Zetek), Apr.–May, 1942, July, 1943–Mar., 1944 (Zetek), June–Oct., 1946 (Zetek).

DYSDERINA PLENA O. Cambridge, 1884

D. plena F. Cambridge, 1899
? *D. plena* Williams, 1941

The Cambridges had this species only from Mexico. Banks had a single female, now in poor condition and may or may not be properly assigned. Mr. Banks ('29) also reported this species from 2 locations in the Canal Zone. Close examination of these shows that the Mt. Hope specimen is a *Scaphiella* (probably *S. barroana* Gertsch) with the right palpal tarsus very poorly developed and that the male from the Canal Zone Biological Area belongs to *D. dura* sp. nov.; the female accompanying the latter probably goes with it. I have not seen the specimens identified by Dr. Gertsch for Dr. Williams as *D. plena* O. Cambridge but in view of my experience with members of this genus from Panama I consider it unlikely that they are correctly assigned.

DYSDERINA RECONDITA sp. nov.

(Figure 4)

Male holotype. Total length 2.00 mm. Carapace .955 mm. long, .755 mm. wide opposite second coxae where it is widest; well rounded along ventral border from opposite palp to posterior border; .377 mm. tall and, therefore, about .50 as tall as wide; quite evenly arched from PME to beginning of steep posterior declivity which begins opposite interval between second and third coxae; surface finely granulated except along ventral border, on top of carapace, and in a few irregular elongate areas elsewhere; quite convex along median region with lateral sides moderately steep; with a sparse covering of short recurved bristles most conspicuous in dorsal area free of granulations.

Eyes. Six in 2 rows; in a moderately compact group, AME lacking; eye group occupies about three-fourths of the width of the carapace at level of posterior row; posterior row gently recurved, measured by posterior borders. Ratio of eyes ALE : PME : PLE = 4 : 4 : 4 (irregularities in outline make determinations of ratios somewhat uncertain). ALE separated by one-half their diameter, from PLE by one-eighth of their diameter, and from PME by one-third of their diameter. PME separated from one another along the whole medial boundary only by a line; tangent to PLE. Hence all eyes are slightly less closely crowded than are those in *D. seclusa* sp. nov. Posterior row wider than anterior row in ratio of 4 : 3. Height of clypeus equal to nearly three-quarters of the greatest width of ALE.

Chelicerae. Vertical, parallel, basal segment .29 mm. long; without a basal boss; with a moderately well developed scopula along promargin of obscure fang groove which has a single small retromarginal tooth near medial end (observed in a dissected paratype to avoid injury to holotype). Fang slender and evenly curved.

Maxillae. Long, slender, somewhat convergent anterior to lip; somewhat notched just anterior to insertion of palp which occurs in basal third; longer than wide at notch in ratio of 13 : 4; with a well developed scopula along oblique medial margin; apex less distinctly hooked than in *D. seclusa* sp. nov., appears to terminate in 2 blunt tubercles.

Lip. Quite strongly chitinized; wider than long in ratio of 17 : 11; distinctly concave in front of posterior border; reaches to middle of maxillae.

Sternum. Nearly scutiform; almost as wide as long; almost equally wide between first and second coxae; strongly chitinized and grooved with more or less distinct lobules opposite the coxae separated by the grooves; separated into 6 remarkably clear areas by the above-mentioned grooves; with a distinct chitinous fold around ventral half of pedicel; sternal suture distinct and procurved; with chitinous bridges which apparently pass dorsally through intercoxal spaces; posterior end blunt and not extended between fourth coxae which are separated by ten-sevenths of their width. Coxae three and four subglobose; coxae one and two somewhat more elongated.

Legs. 4123. Width of first patella at "knee" .0888 mm., tibial index 11. Width of fourth patella at "knee" .0888 mm., tibial index 10.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.666	.268	.555	.450	.266	2.205
2.	.622	.266	.533	.477	.289	2.187
3.	.599	.289	.400	.466	.244	1.998
4.	.733	.333	.533	.622	.311	2.532
Palp	.200	.144	.155	. . .	.400	.899

Two claws, apparently like those recorded for *D. seclusa* sp. nov. Length of palpal tarsus given above is exclusive of embolus and conductor. Trichobothria observed essentially as recorded in *D. seclusa* sp. nov.

Spines. First leg: femur only ventral 0–0–2–2–0 (staggered and so far lateral that they might be considered as such by some workers); patella 0; tibia only ventral 2–2–2–2–1p–0 (the fifth on retromargin appears to have been replaced by a bristle); metatarsus only ventral 2–2–1p (the third on retromargin is replaced by a bristle). Second leg:

essentially as in first with spines generally shorter and less conspicuous. Third and fourth legs devoid of spines. Palp devoid of true spines but with long bristles, especially on the tibia.

Palp. Short, simple, clavate; tarsus quite inflated; tarsal spines (embolus, conductor, etc.) emerge on retrolateral side only about one-seventh from tip (considerably nearer tip than in *D. seclusa* sp. nov.), then separate into a short, moderately broad process which passes transversely toward retrolateral side and is squarely truncated at tip, and a second process which curves into a moderately broad thin hook, expands distally and has a single serration on its anterior surface (Fig. 4).

Abdomen. Ovoid; only moderately separated from cephalothorax by strongly chitinized pedicel; longer than wide in ratio of 47 : 35; widest about two-thirds from base; anal tubercle covered by posterior border of dorsal scutum; spinnerets somewhat retracted but apparently like those seen more clearly in *D. seclusa* sp. nov. Two black recurved bristles appear to mark the position of the reduced colulus. Dorsal scutum covers entire dorsal area. Ventral scutum entire, covers ventral area back to near base of spinnerets. An irregular transverse double row of 10 or 11 stiff black bristles extends across between base of spinnerets and posterior border of ventral scutum. Openings of book-lungs, tracheal spiracle, and genital organs distinct as in *D. seclusa* sp. nov.

Color in alcohol. Essentially as described for *D. seclusa* sp. nov.

Type locality. Male holotype from Boquete, R. P., July, 1939; sifted from debris on forest floor. Two paratype males taken with holotype. Female unknown.

DYSDERINA SECLUSA sp. nov.

(Figure 5)

Male holotype. Total length 1.92 mm. Carapace .888 mm. long; .733 mm. wide opposite second coxae where it is widest; well rounded laterally along ventral border from opposite palp to posterior border; .333 mm. tall and, therefore, about .45 as tall as wide; evenly arched in profile from PME to beginning of steep posterior declivity which begins opposite interval between second and third coxae; surface finely granulated in areas separated by smooth regions; quite convex along median region with sides moderately steep; median thoracic groove lacking.

Eyes. Six in 2 rows; in a moderately compact group; AME lacking; eye group occupies about thirteen-fifteenths of width of carapace at level of posterior row; posterior row gently recurved (some would regard it as straight if measured by posterior borders). Ratio of eyes ALE : PME : PLE = 4.5 : 4.75 : 4.5. All eyes somewhat oval; long axes used for ratios. ALE separated by four-ninths of their diameter, contiguous to PLE and separated by about two-ninths of their diameter from PME. PME contiguous to one another and barely separated from PLE. Posterior row wider than anterior row in ratio of 13 : 10. Height of clypeus equal to about three-fourths of the diameter of ALE.

Chelicerae. Vertical, slightly divergent, outer margins nearly parallel; basal segment .29 mm. long; with no basal boss observed; with a moderately well developed scopula along promargin of obscure and poorly defined fang groove which bears a single small retromarginal tooth near its medial end (observed in a paratype to avoid injury to holotype). Fang slender and evenly curved.

Maxillae. Long, slender, somewhat convergent anterior to lip; about four times as long as wide in middle; swollen near base at insertion of palp; with moderately well developed scopula along medial margin at apex which terminates in a blunt hook.

Lip. Strongly chitinized except along anterior rounded border; wider than long in ratio of about 7 : 5; somewhat concave just in front of posterior border; reaches only about five-twelfths of the length of the maxillae.

Sternum. Nearly scutiform; longer than wide in ratio of 23 : 19; widest between second coxae but nearly as wide between first coxae; strongly chitinized and grooved with more or less distinct lobules opposite each pair of coxae; with a distinct ring around anterior end of pedicel; sternal suture clear and strongly procurved; posterior end bluntly rounded and not extended between fourth coxae which are separated by ten-sevenths of their width. Coxae three and four short and nearly globose; coxae one and two somewhat elongated.

Legs. 4213. Width of first patella at "knee" .0888 mm., tibial index 10. Width of fourth patella at "knee" .0777 mm., tibial index 10.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.644	.266	.599	.466	.31	2.285
2.	.666	.266	.555	.533	.31	2.330
3.	.599	.266	.400	.488	.24	1.993
4.	.734	.266	.510	.650	.32	2.480
Palp	.200	.122	.155	. . .	.33	.810

Claws 2; set on a moderately long onychium; apparently both are simple, similar, each with 2 series of teeth one of which consists of 3 or 4 fairly stout teeth on the proximal two-thirds and the other of 2 or 3 more lateral and more distal in position. Trichobothria on first leg observed as follows: 2 on tibia, 1 at about one-third and another about two-thirds from base; one near distal end of metatarsus; all of these are nearly or quite dorsal in position.

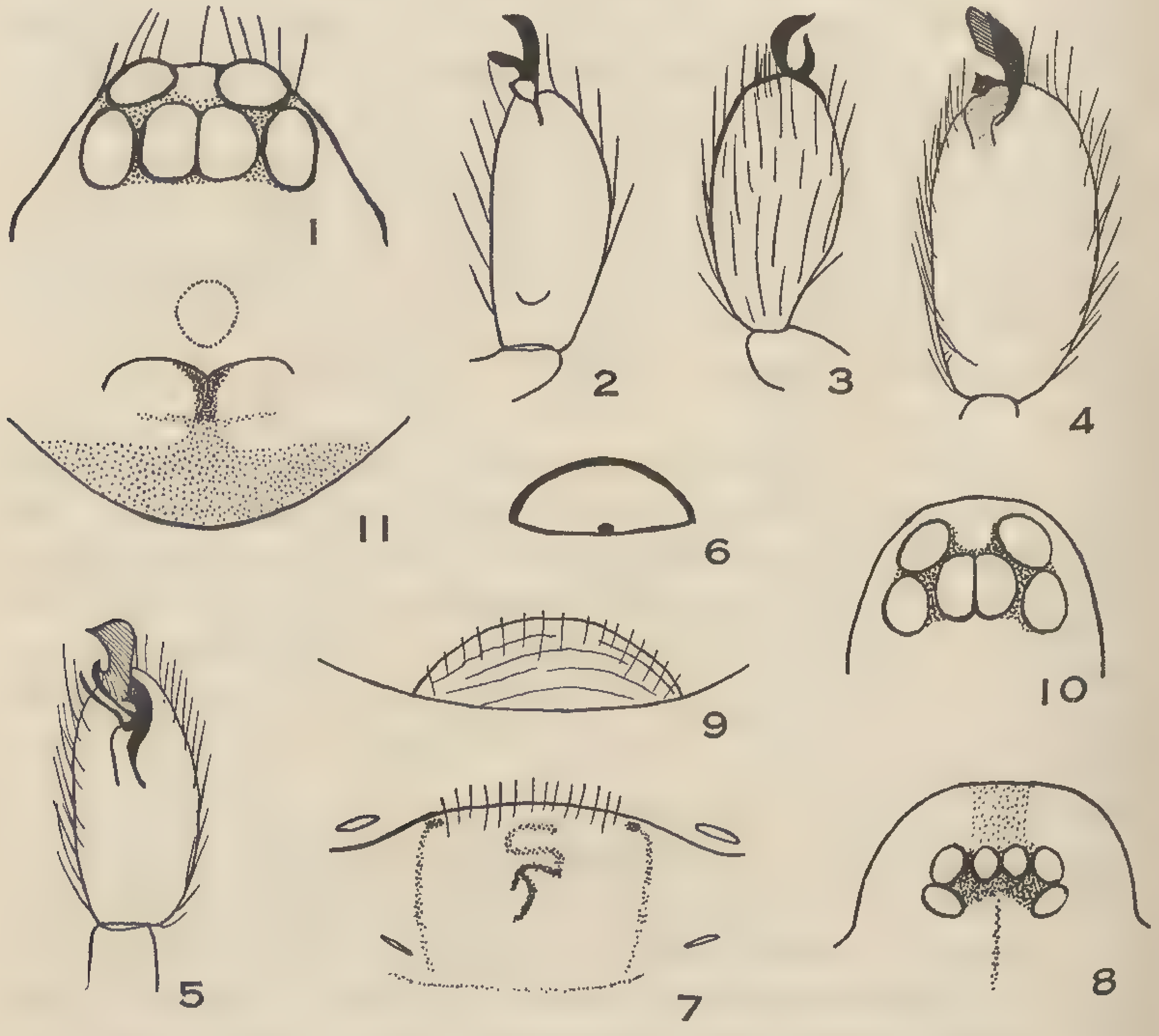
Spines. First leg: femur ventral 0–1r–1r–0–0, prolateral 0–0–1v–1v–0, elsewhere 0 (perhaps these should all be regarded as ventral); tibia only ventral 2–2–2–2–1p–0, second and third more than half as long as segment, others shorter, diminishing distally to fifth; metatarsus only ventral 2 2-1p (the spine which should match with the third of the series on promargin is replaced by a bristle), those on promargin are far displaced toward prolateral surface. Second leg: femoral spines reduced to bristles; patella 0; tibia only ventral 2–2–2–2–0–0; metatarsus only ventral as in first with some additional irregularity. Third and fourth legs without true spines. Palp apparently only with a single long slender prolateral spine near base of tibia.

Palp. Short, simple, clavate; tarsus moderately inflated; tarsal spines (conductor, embolus, etc.) emerge on ventro-retrolateral side about one-third from apex, then separate into a thin, bladelike process which is directed obliquely dorsal in position; the remainder extends as a broad, somewhat concave process with 2 divisions, the first of which runs nearly parallel to the bladelike structure already referred to, and the second of which extends beyond the apex of the bulb as a distinct hook (Fig. 5).

Abdomen. Ovoid; considerably separated from the cephalothorax by a well developed and corrugated pedicel; longer than wide in ratio of 45 : 32; widest near middle; anal tubercle a short flattened cone; six spinnerets in a fairly compact group, all of moderate length and size, middle pair somewhat the shortest and slenderest; with a tuft of 2 or 3 black bristles regarded as marking the site of the reduced colulus. Dorsal scutum covers all of dorsal region except a small area dorsal to anal tubercle; ventral scutum entire, covering anterior end dorsally to meet the dorsal scutum and surrounding the pedicel in a much corrugated band and extending posteriorly for nearly four-fifths of the distance from sexual pore to base of anterior spinnerets; with openings to book-lungs and tracheal spiracles small but distinct; with small central sexual pore opposite tracheal spiracles.

Color in alcohol. Carapace a clear medium brown, darker along ventral border, with black pigment mostly confined to central ocular region around eyes. Sternum somewhat lighter than carapace. Legs, chelicerae, and maxillae a clear brownish-yellow; palps the same with tarsus yellowish-white. Dorsal scutum a clear medium brown; ventral scutum somewhat lighter with "lung" patches much darker.

Type locality. Male holotype from Canal Zone Biological Area; taken in a Berlese funnel sometime between July, 1943 and March, 1944 by Dr. James Zetek. Three paratype males taken over the same period and in the same locality with the holotype. Two male paratypes from the same locality, June-Oct., 1946 by Dr. Zetek. The



External Anatomy of Oonopid Spiders

Figures 1–11

Fig. 1. *Dysderina dura* sp. nov.; eyes, from above.

Figs. 2–3. *D. dura*; male palpal tarsus, nearly ventral and dorsal views, respectively.

Fig. 4. *D. recondita* sp. nov.; male palpal tarsus, nearly ventral view.

Fig. 5. *D. seclusa* sp. nov.; male palpal tarsus, nearly ventral view.

Fig. 6. *D. silvatica* sp. nov.; epigynum.

Fig. 7. *Ischnothyreus peltifer* (Simon); epigynum.

Figs. 8–9. *Oonopinus modestus* sp. nov.; eyes, from above and epigynum, respectively.

Figs. 10–11. *O. pallidulus* sp. nov.; eyes, from above and epigynum, respectively.

females are unknown but are likely to be among numerous females formerly assigned to *D. plena* O. Cambridge. It is difficult to separate the females into species and still more difficult to pair them with the proper males.

DYSDERINA SILVATICA sp. nov.

(Figure 6)

Note: It is difficult to separate out the different species from among the numerous females of this genus now in my collection. I believe this has been done with the species here recognized and described, but it is impossible at this time to be certain as to its relation to the three species of males now recognized from Panama.

Female holotype. Total length 2.20 mm. Carapace .966 mm. long, .799 mm. wide opposite second coxae where it is widest; well rounded along ventral border from opposite palps and including posterior border except a central posterior notch; .355 mm. tall and, therefore, about .44 as tall as wide; quite evenly arched from PME to beginning of steep posterior declivity opposite interval between second and third coxae; surface finely granulated except in several more or less radial areas along lateral sides and a part of the dorsal surface of the carapace; with a sparse covering of short recurved bristles, most conspicuous in dorsal non-granulated area; without a thoracic groove of any kind; moderately convex medially with moderately sloping lateral sides.

Eyes. Six in 2 rows; in a moderately compact group; AME lacking; posterior row occupies twenty-five thirty-seconds of the width of the head at level of posterior borders; posterior row gently recurved, measured by posterior borders. Ratio of eyes ALE : PME : PLE = 4.5 : 4 : 4.5 (irregularity in outline makes ratios somewhat uncertain). ALE separated by slightly less than their radius, from PLE by a line, and from PME by one-fourth their diameter. PME contiguous through nearly one-third of their circumference, barely separated from PLE. Posterior row wider than anterior row in ratio of about 6 : 5. Height of clypeus equal to three-fourths of the greatest diameter of ALE.

Chelicerae. Vertical, essentially parallel by outer margin; basal segment .29 mm. long; with no basal boss; with a moderately well developed scopula along promargin; fang groove obscure and with a single tooth of moderate size near inner end of groove (tooth regarded as retromarginal but in some specimens it appears to be on the promargin). Tooth observed on dissected paratype to avoid injury to holotype.

Maxillae. Moderately long and slender; somewhat convergent distal to lip; somewhat notched laterally just anterior to insertion of palp on basal third; longer than wide at notch in ratio of about 15 : 4; with well developed scopula along oblique medial apical border; pointed distally but without a hook.

Lip. Details of chelicerae, maxillae and lip taken from a dissected paratype to avoid injury to holotype. Quite strongly chitinized; wider than long in ratio of about 8 : 5; somewhat concave just in front of posterior border; bent almost at a right angle near middle; anterior border with an irregular row of stiff bristles.

Sternum. Scutiform; as wide as long; slightly the widest between second coxae but nearly as wide between first coxae; strongly chitinized intricately grooved, and more or less definitely lobulated opposite the coxae; with a distinct chitinous fold passing around ventral half of pedicel; sternal suture distinct and procurved around base of lip; with strongly developed chitinous bridges passing dorsally between coxae; posterior end blunt and not extended between fourth coxae which are separated by ten-sevenths of their width. Third coxae nearly globose, other three pairs more elongated.

Legs. 41 = 23. Width of first patella at "knee" .0888 mm., tibial index 9. Width of fourth patella at "knee" .0888 mm., tibial index 9.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.755	.289	.666	.532	.266	2.508
2.	.733	.266	.644	.599	.266	2.508
3.	.644	.277	.444	.599	.222	2.186
4.	.821	.377	.599	.777	.288	2.862

Trichobothria: palpal tibia with 2 dorsals, one about one-fifth from base and the other about one-third from base; on first leg as described in *D. seclusa* sp. nov. Claws apparently as described in *D. seclusa* sp. nov.

Spines. First leg: only femur ventral 1r–1r–2–1p–0; patella 0; tibia only ventral 2–2–2–2–2 0; metatarsus only ventral 2–2–1p (all staggered somewhat). Second leg: femur as in first except third on retromargin is lacking; patella 0; tibia only ventral 2–2–2–2–1p (all staggered); metatarsus only ventral 2–2–0. Other legs and palp without true spines.

Abdomen. Ovoid; considerably separated from cephalothorax by corrugated and strongly chitinized pedicel; longer than wide (exclusive of pedicel) in ratio of 26 : 21; widest near middle; spinnerets and anal tubercle as usual in genus; dorsal scutum extends over about four-fifths of length of dorsum and leaves a narrow lateral band uncovered; ventral scutum plainly divided by epigastric furrow; anterior part continuous with chitinous covering to pedicel and extending over anterior end of abdomen to meet dorsal scutum above; posterior part extends about eleven-eighteenths of distance from genital groove to base of anterior spinnerets; with a well defined anterior chitinous band extending about half-way around base of spinnerets; position of reduced colulus indicated by a pair of long black bristles just anterior to interval between first pair of spinnerets. Openings to book-lungs and tracheal spiracles distinct.

Epigynum. Extremely simple; only a small oval central opening with a heavily chitinized anterior border and a minute dot near the center of this structure (Fig. 6).

Color in alcohol. Parts of abdomen not covered by scuta (more extensive than in males of the genus) yellowish-white. Elsewhere essentially as described in *D. seclusa* sp. nov.

Type locality. Female holotype from Canal Zone Biological Area, C. Z., August, 1939. Paratype females from the same locality: June–July, 1934; June–July, 1936; June, 1939; Oct.–Dec., 1941 (Zetek); Apr.–May, 1941 (Zetek); July, 1943–March, 1944 (Zetek); Madden Dam region, C. Z., August, 1936, 1939; C. Z. Forest Reserve, August, 1936, July, 1939; Ft. Sherman, C. Z., August, 1939; Gamboa, C. Z., August, 1939; El Valle, R. P., July, 1936.

Genus ISCHNOTHYREUS Simon, 1893

ISCHNOTHYREUS PELTIFER (Simon), 1891

(Figure 7)

Ischnaspis peltifer Simon, 1891
Ischnothyreus peltifer Simon, 1893
I. peltifer Petrunkevitch, 1911
I. peltifer Petrunkevitch, 1929
I. peltifer Bryant, 1940

There are now 2 females in the collection of the Museum of Comparative Zoölogy from Cuba and a male from Bermuda which is thought to be the long missing male for this species, but so far as I know it has never been described. I have 1 female from C. Z. Forest Reserve, C. Z., July, 1939.

Although the epigyna of females in this family are exceedingly simple and singularly lacking in clear and definite characters I think they have some value in separating the species. For this reason I have prepared a simple drawing of the epigynum of *I. peltifer* (Simon) (Fig. 7).

Genus OONOPINUS Simon, 1892

OONOPINUS CENTRALIS Gertsch, 1941

Known only from a male and female collected by Dr. E. C. Williams, Jr., July, 1938, in the Canal Zone Biological Area. The species has not yet appeared in my collections. In a conference with the author of the species, August 6, 1946, it was agreed that the "transverse process" on the palpal bulb mentioned in the text and shown in the drawing is not at the base of the bulb but is in reality at its apex. The bulb is reflected backward so that the distal embolus and conductor come to lie in a basal position whereas they are actually distal.

OONOPINUS MODESTUS sp. nov.

(Figures 8–9)

Female holotype. Total length .888 mm. Carapace .400 mm. long, .355 mm. wide opposite second coxae where it is widest; somewhat irregular along ventral border; moderately convex along median region with lateral sides gently sloping; .155 mm. tall and, therefore, about .44 as tall as wide; eyes on a low protuberance; arches gently from just behind eyes to steep posterior declivity which is moderately abrupt and begins opposite third coxae and is overlapped by anterior end of abdomen; surface smooth and shining except for gentle grooves; provided with a few bristles of moderate length; quite convex in clypeal region.

Eyes. Six in two rows; not compactly arranged; AME presumably lacking; eye group occupies nearly one-half the width of carapace at their level; viewed from above, posterior row strongly recurved so that PME lie between ALE and form with them a nearly straight line. Ratio of eyes ALE : PME : PLE = 2 : 1.75 : 2.25 (median eyes best delimited, others somewhat irregular in outline and difficult to measure). ALE separated from one another by about twelve-sevenths of their diameter, almost in contact with PME, tangent to PLE. PME separated from one another by a line, from PLE by three-fourths of their diameter. PLE separated from one another by about three-halves of their diameter. Posterior row only slightly wider than anterior row (Fig. 8). Height of clypeus equal to three-halves of the diameter of ALE.

Chelicerae. Vertical, parallel, of moderate size for so small a spider; basal segment .18 mm. long; fang slender and evenly curved. Unable to observe fang groove.

Maxillae. Moderately long and slender; convergent beyond lip.

Lip. Nearly twice as wide as long; reaches just beyond middle of chelicerae; membranous with very little chitinization.

Sternum. Broadly scutiform; nearly as broad as long; widest between second coxae but nearly as wide between first coxae; anterior border gently recurved but sternal suture, if present, is too obscure for observation; moderately convex; posterior border recurved and not extended between fourth coxae which are separated by their width; gently grooved opposite intercoxal spaces; all coxae short and subglobose.

Legs. 4123. Width of first patella at "knee" .0444 mm., tibial index 10. Width of fourth patella at "knee" .0444 mm., tibial index 9.

(*All measurements in millimeters*)

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
1.	.422	.111	.355	.266	.200	1.354
2.	.366	.100	.333	.244	.200	1.243
3.	.333	.0999	.266	.222	.200	1.121
4.	.422	.0999	.422	.330	.222	1.496

Spines. Legs and palps appear to be completely devoid of spines.

Abdomen. About one-third overlaps carapace; subglobose; longer than wide in ratio of 4 : 3; .533 mm. long (exclusive of spinnerets); without scuta; openings to book-lungs and tracheal spiracles obscure; colulus appears to be well developed as a brown tubercle between bases of anterior spinnerets which are unnoteworthy, normal to genus.

Epigynum. Only a very simple oval transverse structure with a weakly developed arching anterior lip (Fig. 9).

Color in alcohol. Carapace: yellowish with dull reddish-brown reticulations; black pigment concentrated in ocular region. Sternum brownish with yellowish dots. Legs yellowish, dusted with brownish specks, especially along lateral sides; other appendages similarly colored. Abdomen: reddish-brown with a purplish cast and many minute yellowish dots; from base 2 rows of yellowish dots diverge to near lateral sides of anal tubercle; a similar row extends along lateral sides and another row bounds the venter on each side; venter itself is a lighter reddish-brown with yellowish dots.

Type locality. Female holotype from C. Z. Biological Area, C. Z., June, 1938. Collected by Prof. Alexander Petrunkevitch together with 3 female paratypes one of which was carrying 6 young very loosely bound together. Probably sifted from forest litter.

OONOPINUS PALLIDULUS sp. nov.

(Figures 10–11)

Note: There is some doubt concerning the proper placement of this species. It is provisionally placed here.

Female holotype. Total length 2.353 mm. (not including spinnerets and somewhat protruding chelicerae). Carapace .866 mm. long; .664 mm. wide opposite second coxae where it is widest; moderately well rounded from opposite palp to posterior border; .333 mm. tall and, therefore, almost exactly .50 as tall as wide; rises only slightly behind PME and arches gently to steep posterior declivity which begins opposite third coxae and descends with slight concavity near middle and with moderately steep descent; separated slightly from abdomen but this may be due to distension in handling prior to preservation; surface smooth and shining except for hairs and a few light bristles; considerably convex along median region with lateral sides moderately sloping; considerable iridescence shows in certain light.

Eyes. Six in 2 rows; in a moderately compact group; AME presumably lacking; posterior row occupies eleven-fifteenths of width of carapace at level of posterior borders; posterior row moderately recurved. Ratio of eyes ALE : PME : PLE = 8.5 : 8 : 7.5. PME regularly oval, others somewhat irregular in outline. ALE separated by their radius, barely separated from PME, tangent to PLE. PME contiguous for about one-third of their circumference (Fig. 10), separated from PLE by about one-sixth of their diameter. Posterior row wider than anterior row in ratio of 23 : 19. Height of clypeus equal to width of ALE; with six long stiff bristles just beneath ALE.

Chelicerae. Vertical, parallel, somewhat gibbous in front near base; of moderate size; basal segment .333 mm. long; somewhat excavated along obscure fang groove; fang groove apparently smooth with no teeth.

Maxillae. Moderately robust; slightly convergent; bluntly rounded distally and not narrowed at distal end; only slightly notched near middle.

Lip. Wider than long in ratio of about 7 : 5; reaches to about the beginning of last third of the maxillae; membranous.

Sternum. Scutiform; longer than broad in ratio of 11 : 10; quite convex; with definite lobules opposite each coxa separated by broad shallow grooves; widest opposite second coxae but almost as wide between first coxae; sternal suture obscure but apparently procurved; posterior end blunt and not extended between fourth coxae which are separated by about two-thirds of their width; first and second coxae somewhat elongated, third and fourth short, broad, and quadrilateral.

Legs. 4?123. Width of first patella at "knee" .111 mm., tibial index 13.

(*All measurements in millimeters*)

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
1.	.644	.333	.533	.466	.289	2.265
2.	.644	.355	.466	.466	.266	2.197
3.	.553	.222	.377	.422	.222	1.796
4.	.710	All other segments lacking				????

Many of the spiniform hairs on legs are scaly or spiny along each shaft. Trichobothria observed on first legs as follows: 1 near distal end and 1 near proximal end of tibia; 1 near distal end of metatarsus; all of these are dorsal in position; all are of the ordinary long slender type with many short lateral branches. In addition to these there are several short erect modified hairs suggesting some sensory function. There are 2 claws set on a strongly and transversely grooved onychium; each claw shows a series of prominent teeth clearly, but probably has a second set of smaller ones; with numerous modified hairs on onychium.

Spines. Apparently, although there are many spiniform hairs on first and second legs, true spines are lacking on these appendages. The third leg bears transparent spines as follows: tibia ventral 0–1p–2 (distal), prolateral 0–0–1–0, retrolateral 0–0–1–0; metatarsus ventral 0–1p–1r, prolateral 0–1–1, retrolateral 0–0–1–0.

Abdomen. Ovoid; 1.40 mm. long; longer than wide in ratio of 63 : 35; openings to book-lungs and tracheal spiracles very obscure; 2 long black bristles appear to indicate position of reduced colulus between bases of anterior spinnerets; spinnerets in a compact group, much longer than usual in the oonopids from Panama, anterior and posterior pairs equally long, surround and obscure the middle pair. There seems to be a small, mildly developed epigastric scutum covering a small area anterior to epigynal region and extending to the beginning of the pedicel; with a moderate coating of fine light-colored hair.

Epigynum. Simple but more developed than usual in oonopids; somewhat swollen over whole region; a central spermatheca of moderate size lies a considerable distance in front of epigastric furrow; just behind this lies a central chitinized region with anteriorly diverging extensions which seem to form anterior borders for 2 shallow depressions; a weakly chitinized area lies just in front of the procurved posterior border (Fig. 11).

Color in alcohol. Black pigment concentrated in ocular region. Cephalothorax and appendages almost unicolored light yellowish.

Abdomen nearly white. A moderate amount of iridescence appears on all parts of body and legs.

Type locality. Female holotype from C. Z. Biological Area, C. Z., July, 1934. No paratypes.

Genus OONOPOIDES Bryant, 1940

OONOPOIDES BRYANTAE sp. nov.

(Figures 12–13)

Male holotype. Total length 1.199 mm. Carapace .599 mm. long; .447 mm. wide opposite second coxae where it is widest; quite well rounded from opposite palp to posterior border; .244 mm. tall and, therefore, about .54 as tall as wide; evenly arched from PME to beginning of posterior declivity opposite third coxae from which place the descent is moderately steep; steep declivity largely overlapped by anterior end of abdomen; quite convex along central region with lateral sides moderately sloping; with a scanty covering of short dark bristles and 6 longer bristles in a complete row over posterior lateral corners to dorsum; with no definite thoracic groove visible; surface smooth and shining.

Eyes. Six in 2 rows, in a moderately compact group; with AME lacking; posterior row occupies slightly more than nine-elevenths of the width of the carapace at that level; posterior row moderately recurved. Ratio of eyes ALE : PME : PLE = 5 : 6 : 5.5 (ventral borders of ALE and PLE obscure). ALE separated from one another by about four-fifths of their diameter, barely separated from PME and PLE. PME separated from one another by a moderately heavy line, slightly separated from PLE (Fig. 12). Posterior row wider than anterior row in ratio of 9 : 7. Height of clypeus equal to about one-fourth of the diameter of ALE, almost lacking.

Chelicerae. Vertical, essentially parallel; fairly long for so small a spider, slender; .177 mm. long; impossible to examine fang groove without injury to holotype; fang apparently moderately long and evenly curved.

Maxillae. Convergent; long and slender; with distal ends somewhat knobbed and turned outward and ventrally much as described in the genotype of *O. maxillaris* Bryant.

Lip. Deeply grooved at base, somewhat notched distally; only slightly wider than long.

Sternum. Scutiform; longer than wide in ratio of 17 : 16; quite strongly convex; moderately grooved opposite intercoxal spaces; posterior end bluntly truncated, not extended between fourth coxae which are separated by slightly more than their width; widest between second coxae but nearly as wide between first coxae; sternal suture obscure but apparently very gently procurved; first coxae somewhat elongated, all others quite globose.

Legs. 4123. Width of first patella at "knee" .0555 mm., tibial index 10. Width of fourth patella at "knee" .0555 mm., tibial index 9.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.444	.175	.360	.288	.288	1.555
2.	.399	.177	.289	.266	.266	1.397
3.	.377	.140	.266	.311	.244	1.338
4.	.488	.200	.400	.355	.288	1.731
Palp	.122	.111	.056	. . .	.177	.466

Length of palpal tarsus is exclusive of the long embolus. Trichobothria observed on fourth leg as follows: tibia, 1 near proximal end and another about one-third from distal end; metatarsus, 1 near distal end; all of these are dorsal. Claws: 2 on an onychium, both apparently with 2 series of teeth.

Spines. Although many spiniform hairs are present, true spines appear to be completely lacking.

Palp. Short; considerably modified; femora considerably deepened dorsoventrally, but not swollen so much laterally; patella swollen, somewhat grooved; tibia very short and globose; tarsus quite inflated, simple, with a very long flagellate embolus (Fig. 13).

Abdomen. Ovoid; .644 mm. long; only anterior one-seventh overlaps carapace; longer than wide in ratio of 29 : 18; widest in middle, bluntly rounded at both ends; without scuta; 6 spinnerets compactly grouped, fairly prominent but not excessively elongated as in genotype, posterior pair somewhat the longest; anal tubercle a short, yellowish-white, flattened cone; openings to book-lungs and tracheal spiracles obscure.

Color in alcohol. Cephalothorax and all appendages a clear yellowish with variations. Abdomen: generally a dark purplish-brown; cardiac region clear and transparent; dorsum and lateral sides subdivided into quadrilateral areas by indefinite transverse bars and longitudinal stripes; each area in turn reticulated by small irregular dark spots on a yellowish white ground; venter nearly white with small brownish spots along ventrolateral sides.

Type locality. Male holotype from C. Z. Biological Area, C. Z., July, 1943–March, 1944. Taken in a Berlese funnel by Dr. James Zetek. No paratypes.

Note: It seems quite possible that *O. bryantae* sp. nov. is the male of *Oonops reticulatus* Petrunkevitch from Panama City.

Genus OONOPS Templeton, 1834

OONOPS DONALDI sp. nov.

(Figures 14–16)

Male holotype. Total length 1.60 mm. Carapace .733 mm. long; .599 mm. wide opposite interval between second and third coxae where it is widest; well rounded along ventral margin from just behind posterior row of eyes to posterior border. Rises dorsally behind PME considerably to nearly opposite third coxae from which posterior declivity descends abruptly and with moderate concavity; markedly convex with lateral sides sloping outward; with a considerable space between ventral margin and base of coxae; .333 mm. tall and, therefore, about .56 as tall as wide. No definite median longitudinal thoracic groove visible.

Eyes. Six eyes in 2 rows; all oval: AME lacking; in a moderately compact group; all nocturnal; posterior row moderately recurved; posterior row wider than anterior row in ratio of 4 : 3. Ratio of eyes ALE : PME : PLE = 4.5 : 5 : 4. ALE separated from one another by two-thirds of their long axis, only slightly separated from PLE and PME. PME contiguous, slightly separated from PLE. Width of clypeus equal to five-ninths of the long axis of ALE. Numerous long slender bristles in region of eyes; all eyes surrounded by black pigment (Fig. 14).

Chelicerae. Vertical, parallel, basal segment .244 mm. long; without basal boss; fang slender, evenly curved; fang groove indistinct and without teeth, but with a scanty scopula along promargin.

Maxillae. Convergent; with a chitinous retrolateral ridge; grooved distally; with a chitinous distal hook.

Lip. About as long as wide; reaches to middle of maxillae. Sternal suture obscure, possibly lacking.

Sternum. Convex; cordiform; as wide as long; widest between second coxae, but nearly as wide between first coxae; with a scanty coating of slender bristles; posterior end a blunt point not extended between fourth coxae which are separated by seven-sixths of their width.

Legs. 4213. Width of first patella at "knee" .0777 mm., tibial index 11. Width of fourth patella at "knee" .0666 mm., tibial index 8.

(All measurements in millimeters)

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
1.	.533	.222	.511	.444	.200	1.910
2.	.622	.266	.599	.533	.198	2.218
3.	.533	.200	.333	.466	.200	1.732
4.	.777	.245	.555	.666	.222	2.465
Palp	.178	.089	.154	...	.222	.643

Two claws, simple, curved, similar, each with 3 or 4 teeth; on a long onychium. Trichobothria observed as follows on fourth leg: patella, 1 about one-third from base; tibia, 3 in basal two-thirds; metatarsus 2, 1 near proximal end and 1 near distal end; all dorsal or nearly so; tarsus with a single dorsal spiniform erect bristle near middle. All trichobothria appear to be scaled or finely serrated throughout their length.

Spines. Many hairs are spiniform. First leg: femur dorsal 0–1–0, prolateral 0–0–1–1–0, retrolateral 0, ventral 0–0–1r–1r–0 (prolateral and ventral might be considered together as 2 pairs by some); patella 0; tibia only ventral 2–2–2–2–2 bristles; metatarsus 2–2–2–2 (last pair hardly more than bristles). Second leg: essentially as in first. Third leg: femur only dorsal 0–1–1–1–0; patella apparently only prolateral 0–1 (slender)–0; tibia dorsal 0–1–0, prolateral 0–1–0, retrolateral 0–1–1–0, ventral 0–0–2 (retromarginal, hardly more than a bristle); metatarsus dorsal 0–0–1–1–1 (all staggered), prolateral 1–1–1, retrolateral 0–0–1, ventral 0–0–2. Fourth leg apparently as in third. Some spines are probably removed in handling and scars are difficult to see.

Palp. With bulb only moderately dilated; with 2 terminal spines, the conductor is slender, pointed, and transparent; the embolus is long, twisted, geniculate near tip and black for most of its length (Figs. 15–16).

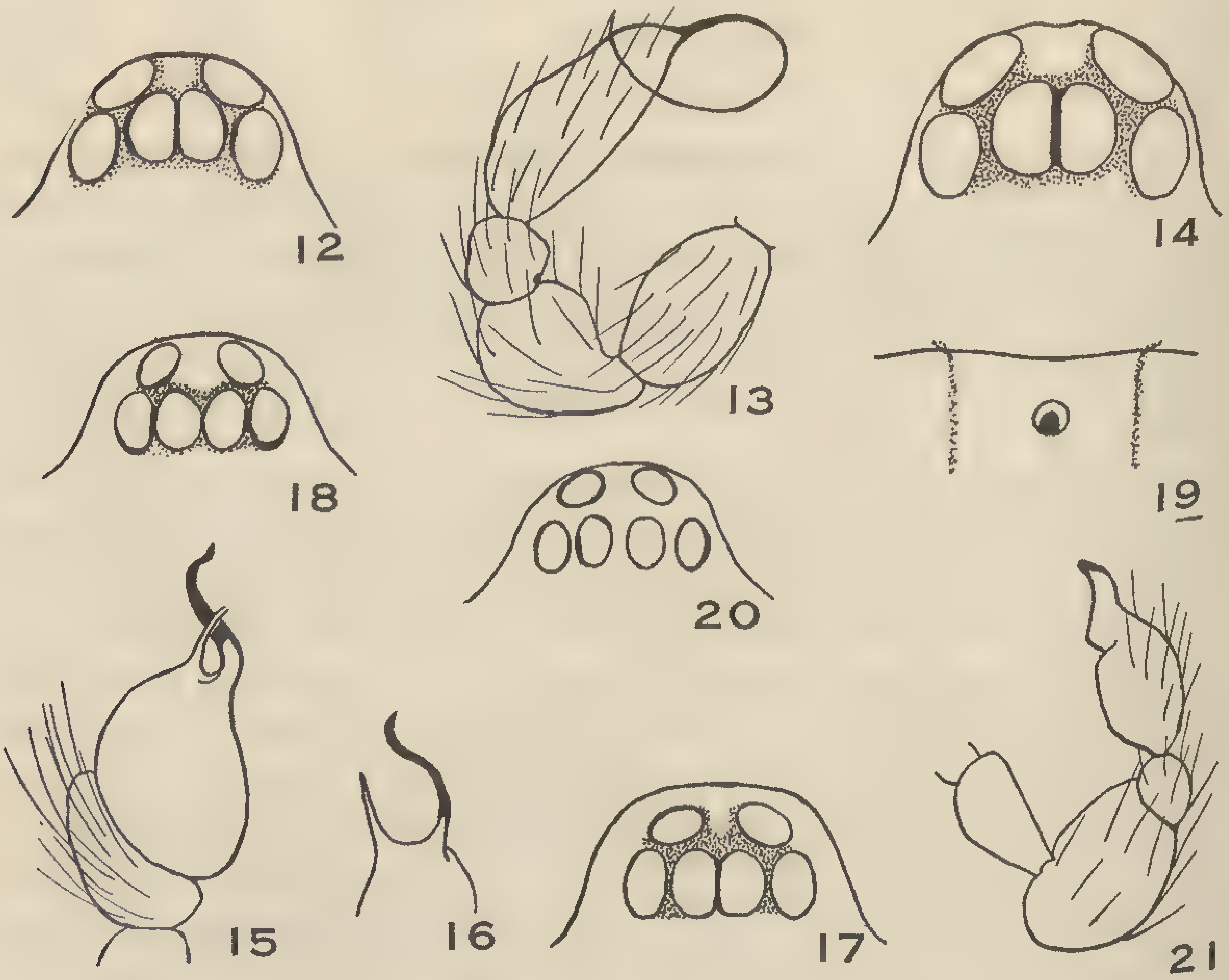
Abdomen. With no scuta; without special sclerites around spinnerets or pedicel. Simple, ovoid. Lung openings and spiracles obscure. Spinnerets 6, slender; anterior pair approximated at bases, diverging distally; middle pair slenderest; all of moderate length. No colulus observed.

Color in alcohol. Abdomen almost white; elsewhere yellowish-white with carapace somewhat the darkest; black pigment restricted to ocular area.

Type locality. Male holotype from Ft. Davis, C. Z., August, 1936. One male paratype from El Valle, R. P., July, 1936.

OONOPS RETICULATUS Petrunkevitch, 1925

Dr. Petrunkevitch had a single female from Panama City, R. P. This type is now sectioned for the study of internal anatomy and is, therefore, unavailable for taxonomic purposes. Unless *Oonopoides bryantae* sp. nov. should prove to be the same, the species has not yet appeared in my collection.



External Anatomy of Oonopid Spiders

Figures 12–21

Figs. 12–13. *Oonopoides bryantae* sp. nov.; eyes, from above and male palp, respectively.

Figs. 14–16. *Oonops donaldi* sp. nov.; eyes, from above and male palp (two views), respectively.

Fig. 17. *O. zeteki* sp. nov.; eyes, from above.

Figs. 18–19. *Opopaea recondita* sp. nov.; eyes, from above and epigynum, respectively.

Figs. 20–21. *O. timida* sp. nov.; eyes, from above and male palp, respectively.

OONOPS ZETEKI sp. nov.

(Figure 17)

Female holotype. Total length 1.865 mm. Carapace .777 mm. long; .688 mm. wide opposite second coxae where it is widest; well rounded from opposite palps to posterior border; .311 mm. tall and, therefore, about .45 as tall as wide; rises gently behind PME to posterior declivity which begins opposite third coxae and continues fairly steeply to posterior border; barely separated from abdomen; surface finely and irregularly wrinkled in a longitudinal direction.

Eyes. Six in 2 rows; in a moderately compact group; AME presumably lacking; posterior row occupies five-eighths of width of carapace at level of posterior borders; posterior row either straight or slightly recurved (by posterior borders). Ratio of eyes ALE : PME : PLE = 3.5 : 3.6 : 3.75 (by long axes); exactitude is difficult because of irregularities in margins. ALE separated from one another by one-third of their long diameter; from PME by an equal distance; barely separated from PLE. PME contiguous for nearly one-third of their circumference; tangent to PLE. Posterior row wider than anterior row in ratio of about 5 : 4. Height of clypeus equal to about one-half the long diameter of ALE. Clypeus somewhat inclined forward.

Chelicerae. Vertical, slightly convergent; moderately robust; basal segment .222 mm. long; strongly excavated medially in basal three-fifths so that a somewhat oval opening is formed between them; fang groove obscure, with a single small tooth near inner or medial end which I consider retromarginal; fang slender, evenly curved; a moderately well-developed scopula along obscure promargin of fang groove.

Maxillae. Moderately convergent; lightly chitinized; somewhat tapering distally; with a moderately well-developed scopula; slightly more than twice as long as wide in middle. Some details of fang groove, maxillae and lip taken from dissected paratype to avoid injury to holotype.

Lip. Wider than long in ratio of 5 : 4; anterior border rounded; reaches to about the end of the middle third of length of maxillae; with a procurved sternal suture.

Sternum. Scutiform; quite convex; about as wide as long; widest between second coxae but nearly as wide between first coxae; without transverse grooves and with scarcely discernible lobules opposite coxae; posterior end squarely truncated and not extended between fourth coxae which are separated by seven-sixths of their width; first and second coxae considerably elongated, third and fourth shorter but none globose or even subglobose.

Legs. 4123. Width of first patella at "knee" .0999 mm., tibial index 12. Width of fourth patella at "knee" .0888 mm., tibial index 11.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.577	.266	.555	.444	.266	2.108
2.	.577	.244	.533	.444	.266	2.064
3.	.555	.244	.355	.444	.289	1.887
4.	.688	.289	.511	.599	.333	2.420

Trichobothria observed on first leg of paratype as follows: tibia with 1 about one-third from base, another about one-third from distal end; both dorsal. Palpal tibia also with 2 trichobothria near middle and essentially dorsal in position. Palp without a claw. Two claws, both apparently similar and each with 2 sets of teeth essentially as recorded for other members of the family.

Spines. First leg: femur prolateral 0–0–1–1–0, ventral 0–1r–1r–0, elsewhere 0; patella 0; tibia only ventral 2–2–2–2–1p–0; metatarsus only ventral 2–2–1p (somewhat irregular in position). All spines of first leg long, robust, apparently erectile. Second leg: essentially as in first except spines are less robust. True spines appear to be lacking on third and fourth legs.

Abdomen. Ovoid; 1.07 mm. long; longer than wide in ratio of nearly 4 : 3; widest near middle; no signs of dorsal or ventral scutum; spinnerets in a compact group; anterior spinnerets with bases closely approximated and apparently with remains of reduced colulus between their bases indicated by a pair of black bristles; a sparse coating of short dark recurved hairs; openings of book-lungs, tracheal spiracles very obscure.

Epigynum. With no indication of an epigynal plate except a small central whitish swelling.

Color in alcohol. Carapace yellowish, darkened a little toward ventral border, black pigment surrounding all eyes except a ventral arc of PLE. Appendages yellowish-white, somewhat lighter below. Abdomen nearly white.

Type locality. Female holotype and four female paratypes taken in the C. Z. Biological Area, July, 1943–March, 1944 by Dr. James Zetek in a Berlese funnel.

Genus OPOPAEA Simon, 1891

OPOPAEA RECONDITA sp. nov.

(Figures 18–19)

Female holotype. Total length 1.35 mm. Carapace .576 mm. long; .466 mm. wide opposite interval between second and third coxae where it is widest; considerably narrowed opposite palps; rises somewhat behind posterior row of eyes and then continues nearly level almost to opposite posterior coxae where steep posterior declivity begins; posterior declivity somewhat concave; .222 mm. tall and, therefore, about .48 as tall as wide; quite convex; with numerous minute pits, those on lateral sides tending to occur in irregular longitudinal rows; ventral border strongly chitinized but whole carapace is well chitinized; with a row of 6 or 7 short stout bristles arranged transversely just at beginning of posterior declivity; without a median longitudinal thoracic groove.

Eyes. Six in 2 rows; arranged in a compact group; AME lacking. All eyes nocturnal. Posterior row slightly recurved. Ratio of eyes ALE : PME : PLE = 5.5 : 5 : 4. All eyes somewhat oval. ALE separated by about their long radius, barely separated from PLE and PME. PME separated only by a narrow line, from PLE by a broader line; black pigment concentrated around PME (Fig. 18). Clypeus heavily margined; with width equal to about three-fourths of the short diameter of ALE.

Chelicerae. Coniform; nearly vertical but perhaps directed backward slightly; basal segment .18 mm. long; probably without a basal boss; fang slender; fang groove and teeth not observed because of danger of injury to holotype.

Maxillae. Moderately convergent, slender, rather deeply indented just distal to insertion of palp which occurs on middle third; reaches somewhat beyond tip of lip.

Lip. Nearly triangular; slightly wider at base than long; sternal suture obscure but apparently present and nearly straight.

Sternum. Heavily chitinized; moderately lobulated opposite each coxa; longer than wide in ratio of 9 : 7; widest opposite interval between first and second coxae; moderately convex; first coxae wide apart; posterior end a blunt truncation and not extended between fourth coxae which are separated by about six-fifths of their width.

Legs. 4123. Width of first patella at "knee" .0610 mm., tibial index 11. Width of fourth patella at "knee" .0610 mm., tibial index 10.

(*All measurements in millimeters*)

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
1.	.311	.195	.199	.188	.120	1.013
2.	.300	.177	.195	.177	.111	.960
3.	.266	.111	.155	.155	.111	.798
4.	.333	.200	.255	.222	.130	1.140

Femora raised and greatly deepened near proximal end, especially so on first and second legs. Claws 2, on a coniform onychium, apparently simple, curved, similar, and with five or six teeth each. Trichobothria definitely observed; posterior leg: tibia with 3, long, slender, nearly dorsal in position, metatarsus with 1 dorsal near distal end of segment, tarsus with a single short stout one. All trichobothria apparently serrated or, perhaps, scaled. Third leg appears to bear trichobothria essentially like the fourth.

Spines. Legs are probably to be considered as spineless. Under high magnification the hairs appear spiniform and many appear to be finely serrated.

Abdomen. With a dorsal scutum covering the entire surface and a somewhat smaller ventral scutum separated at the epigastric furrow into an anterior plate, which extends dorsally for a considerable distance and makes a well defined chitinous ring around the pedicel, and a posterior plate, which covers the venter to the base of the spinnerets and extends dorsally nearly to the dorsal scutum. The 2 scuta are close together anteriorly but separate further posteriorly. Tracheal spiracles are 2 small oval openings a short distance behind the lung slits. I see no chitinous sclerite at base of spinnerets such as that described by Petrunkevitch ('29) in *O. lutzi*. Almost a perfect oval, nearly flat dorsally, longer than wide in ratio of 18 : 13, widest just behind the middle. Scuta shiny and finely pitted; lightly pubescent. Spinnerets small and obscure; anterior pair longest and somewhat separated; others poorly observed because of reluctance to endanger the holotype by more careful examination and the necessary handling. No colulus observed.

Epigynum. Very simple; with no very definite plate but with a small chitinized "button" between tracheal spiracles and 2 widely separated internal tubes. (Fig. 19).

Color in alcohol. All appendages light brown. Carapace, sternum, and abdominal scuta a rich medium brown. Lightly chitinized regions between scuta yellowish-white.

Type locality. Female holotype taken in Berlese funnel by Dr. James Zetek, C. Z. Biological Area, C. Z., July, 1943–Mar., 1944. No paratypes.

OPOPAEA TIMIDA sp. nov.

(Figures 20–21)

The male described here is in the collection of the Museum of Comparative Zoölogy. It is believed to have been taken from a bat, *Dirias albiventer minor,* collected in the Chilibrillo caves of the Panama Canal Zone by Dr. L. H. Dunn. The exact date of its collection is uncertain, but it is thought to have been about 1936. The specimen was at first regarded as the allotype of *O. recondita* sp. nov. but continued study of the two seemed to indicate that they probably do not belong together. Hence this specimen is described as the holotype of a species new to science.

Holotype male. Not in good condition in several respects; the preservation is defective, but such structures as palps are undamaged. Total length about 1.40 mm. Carapace .53 mm. long; .47 mm. wide opposite interval between second and third legs where it is widest; well rounded from opposite posterior row of eyes to posterior border; only moderately narrowed opposite palps; rises only slightly just behind PME, then nearly flat to opposite third coxae where steep posterior declivity begins; declivity steep to posterior border which is strongly chitinized; apparently without a median longitudinal thoracic groove; with small and obscure pits tending to appear in irregular rows along lateral sides; .1998 mm. tall and, therefore, about .43 as tall as wide.

Eyes. Six in a fairly compact group in 2 rows; AME lacking; much more separated than in *O. recondita* sp. nov.; all eyes nocturnal; posterior row slightly recurved; posterior row wider than anterior row in ratio of 8 : 5.5. Ratio of eyes ALE : PME : PLE = 4 : 3.5 : 3. ALE separated by nearly their diameter, from PLE and PME by a little more than their radius; PME separated by their radius, from PLE by their radius. Width of clypeus equal to radius of AME.

Chelicerae. Essentially coniform; nearly vertical; basal segment .167 mm. long, probably without basal boss; fang slender, evenly curved; fang groove obscure, no teeth observed.

Maxillae. Convergent; pointed distally, enlarged at bases; with palp inserted into middle third; reach well beyond tip of lip.

Lip. Nearly triangular; apparently wider at base than long in ratio of nearly 2 : 1 (limitations difficult to see because of poor preservation).

Sternum. Quite convex; moderately lobulated opposite each coxa; heavily chitinized; longer than wide in ratio of 17 : 14; widest opposite interval between second and third coxae, nearly as wide between first coxae; posterior end squarely truncated and not extended between fourth coxae which are separated by seven-fifths of their greatest width.

Legs. 4123. Width of first patella at "knee" .0444 mm., tibial index 12; width of fourth patella at "knee" .0555 mm., tibial index 13.

(*All measurements in millimeters*)

	Femora	*Patella*	*Tibia*	*Metatarsi*	*Tarsi*	*Totals*
1.	.333	.156	.200	.200	.145	1.034
2.	.311	.178	.222	.167	.133	1.011
3.	.244	.133	.167	.167	.133	.844
4.	.377	.155	.289	.244	.155	1.220
Palp	.0999	.1776	.0333	...	.1887	.4995

Two claws on a coniform onychium (badly distorted by defective preservation); simple, curved, similar, and with about 5 teeth. Trichobothria definitely present but preservation so defective that they do not show well and, hence, are not recorded.

Spines. Legs without true spines, but hairs, well distributed, appear under high magnification to be spiniform.

Palp. With a short tibia, a much dilated patella, and a simple tarsus (Fig. 21).

Abdomen. With a dorsal scutum covering entire dorsal surface; a somewhat smaller ventral scutum appears to be incompletely separated into two at the epigastric groove; with a distinct chitinous ring around pedicel. A chitinous sclerite at base of spinnerets may be present as in *O. lutzi* Petrunkevitch ('29) but the shrunken condition of holotype obscures a clear view of the region. Almost a perfect oval, viewed from above; nearly flat dorsally; longer than wide in ratio of 13 : 8, widest about two-thirds from base.

Color in alcohol. All appendages light brownish; body generally a clear brownish, somewhat lighter beneath.

Type locality. Male holotype believed to have been taken from a bat as described elsewhere; from the caves at Chilibre, Panama Canal Zone, about 1936. No paratypes.

Genus SCAPHIELLA Simon, 1891

SCAPHIELLA BARROANA Gertsch, 1941

(Figures 22–23)

Dr. Gertsch had both sexes of this species from the C. Z. Biological Area. The following items may be added to those given in the original description: (1) The epigynum is, as usual in the family, very simple, but it is definitely different from corresponding organs in the other 2 species from Panama; the opening in the center is somewhat oval; on each lateral side of the opening occurs the usual small dark spot characteristic of the genus; above the middle of the central opening there is a small retro-curved crescent shaped mark connected to the anterior rim by a short line (Fig. 22). On the female palp near base of tibia is a pair of trichobothria of the type common in these oonopids. (2) The structures reported as 2 black teeth on margins of fang groove in the female allotype of *S. williamsi* Gertsch ('41) are clearly seen here to be a pair of curiously shaped digitate spines (Fig. 23) so far forward on prolateral surface as to be unrelated probably to the fang groove. (3) The scopula is composed of serrated and branched bristles or hairs. (4) The fang is delicate and curled into more than a semicircle. (5) There may be no tooth on fang groove, but I think there is a single small retromarginal tooth near medial end and not far from special spines. It seems to be visible in the males who also have the modified spines recorded for the females.

Collection records. C. Z. Biological Area, C. Z., Oct.–Dec., 1941; July, 1943–Mar., 1944. All taken with a Berlese funnel by Dr. James Zetek.

SCAPHIELLA GERTSCHI sp. nov.

(Figures 24–27)

Male holotype. Total length 1.554 mm. Carapace .666 mm. long, .511 mm. wide opposite second coxae where it is widest; moderately well rounded along ventral border from opposite palp to posterior border; .266 mm. tall and, therefore, .52 as tall as wide; only very slightly raised behind PME, nearly level to beginning of posterior declivity opposite third coxae; posterior declivity at first quite abrupt, then somewhat concave, later gradually sloping to posterior border; surface generally smooth, border with short, obscure tubercles; without a median thoracic groove of any kind; with a sparse covering of short, mostly recurved bristles; moderately convex along middle longitudinally and with moderately sloping lateral sides.

Eyes. Six in 2 rows, in a compact group; AME lacking; posterior row occupies about three-fourths of width of carapace at level of posterior borders; posterior row gently recurved, measured by posterior borders. Ratio of eyes ALE : PME : PLE = 3.5 : 3 : 3.5. ALE nearly round; others distinctly oval; all regular in outline (long axis used for measurements). ALE barely separated from one another and from PLE, separated from PME by their radius. PME contiguous to one another and to PLE for about one-fourth of their circumference. Posterior row wider than anterior row in ratio of 9 : 7 (Fig. 24). Height of clypeus equal to about the diameter of ALE.

Chelicerae. Vertical, essentially parallel; fairly robust for so small a spider; basal segment .16 mm. long; somewhat excavated near base in front; apparently without a basal boss; with a moderately well developed scopula along promargin of obscure fang groove; certainty is impossible, but it seems probable that there is a retromarginal tooth on fang groove and, perhaps, also a promarginal one. Fang moderately robust for so small a spider and evenly curved.

Maxillae. Of characteristic form; strongly convergent; almost transverse (Fig. 25); of moderate length; concave anteriorly to insertion of palp; apparently with a small attenuated distal end; appear to be 2 small teeth near base of trochanter of palp.

Lip. Moderately well chitinized; about as wide as long; reaches almost to apex of strongly convergent maxillae; apparently with an obscure, gently procurved sternal suture.

Sternum. Somewhat scutiform; longer than wide in ratio of about 19 : 15; widest between second coxae but nearly as wide between first coxae; smooth and shining without grooves and without noticeable lobules; with a sparse covering of moderately long black bristles; posterior end blunt and not extended between fourth coxae which are separated by four-thirds of their width. All coxae quite globose except the first pair.

Legs. 4123. Width of first patella at "knee" .0666 mm., tibial index 12. Width of fourth patella at "knee" .0666 mm., tibial index 10.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
		(*All measurements in millimeters*)				
1.	.445	.222	.322	.311	.222	1.522
2.	.400	.222	.289	.288	.199	1.398
3.	.355	.178	.244	.266	.199	1.242
4.	.511	.244	.401	.355	.266	1.777
Palp	.222	.133	.111	. . .	.311	.777

Claws and trichobothria not observed because of danger of damage to holotype by treatment necessary for examination under high magnification.

Spines. True spines appear to be entirely lacking.

Palp. Short, clavate; femur somewhat curved medially; tibia nearly as wide as long, about .84 as long as patella; tarsus strongly inflated, of the same form as in *S. barroana* Gertsch and *S. williamsi* Gertsch, with tubercle and embolus arising more distally than in either of the previously known species from Panama (Fig. 26); embolus somewhat shorter than in *S. barroana*, without a lateral tuft of modified hairs such as occurs in *S. barroana* Gertsch.

Abdomen. Cephalothorax and abdomen only slightly separated so that species would not, probably, be considered pedunculate; .96 mm. long exclusive of the pedicel; longer than wide in ratio of a little more than 2 : 1; dorsal scutum covers all but a small area dorsal and dorsolateral to anal tubercle; ventral scutum entire, includes pedicel and base of abdomen and extends posteriorly close to base of spinnerets where a moderately well developed chitinous band surrounds spinnerets on ventral half; 2 black bristles appear to indicate position of reduced colulus; with a small central genital pore but with openings to book-lungs and tracheal spiracles very obscure.

Color in alcohol. Color as described by Gertsch ('41) in *S. barroana* and *S. williamsi.*

Female allotype. Total length 1.687 mm. Carapace .721 mm. long; .555 mm. wide; .244 mm. tall and, therefore, about .44 as tall as wide; just at beginning of steep posterior declivity there appears a pair of long erect bristles (perhaps broken off in male). Otherwise essentially as in male.

Eyes. Posterior row occupies about nine-fourteenths of width of carapace at level of posterior borders; posterior row straight or slightly procurved. Ratio of eyes ALE : PME : PLE = 7.5 : 6 : 7. These ratios are taken from long axes. ALE appear to be considerably larger because they are nearly circular. Height of clypeus equal to about six-sevenths of the diameter of ALE. Otherwise essentially as in male.

Chelicerae. A single, moderately robust, retromarginal (?) tooth on the fang groove shows clearly. Otherwise essentially as in male.

Maxillae. Much less modified than in male, but without significant differences.

Lip and *Sternum.* Essentially as in male.

Legs. 4123. Width of first patella at "knee" .0555 mm., tibial index 10. Width of fourth patella at "knee" .0666 mm., tibial index 9.

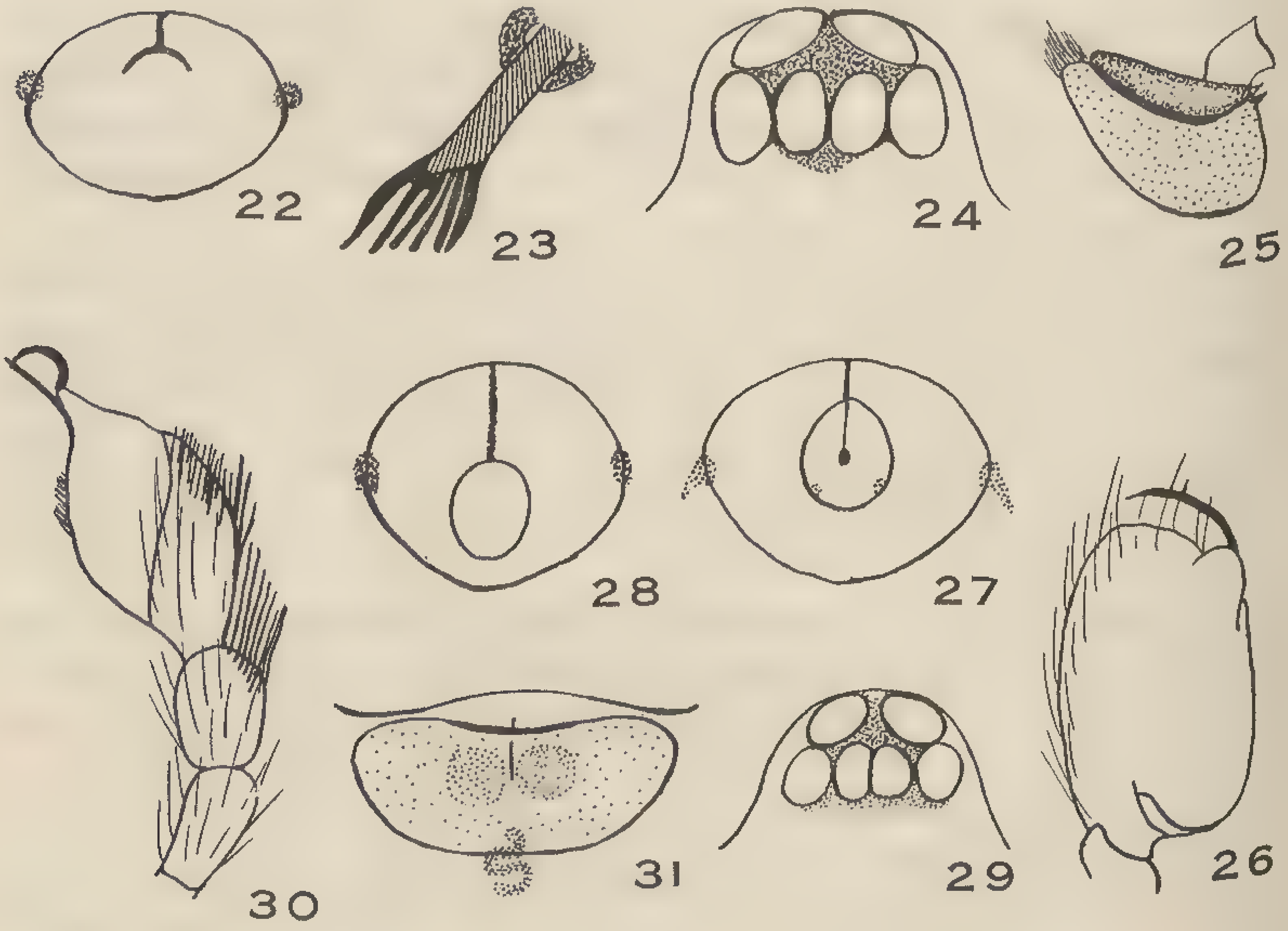
	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.444	.198	.333	.311	.244	1.530
2.	.420	.222	.288	.288	.222	1.445
3.	.395	.195	.266	.277	.222	1.355
4.	.555	.266	.444	.400	.288	1.953

Palpal tibia with a pair of trichobothria, 1 near distal end and 1 near proximal end. First leg observed with trichobothria as follows: none on metatarsus; 2 on dorsal surface of tibia, 1 near each end. Claws 2, with much the same arrangement of teeth as in *Dysderina.*

Spines. The dorsal and ventral spiniform hairs on first and second femora are close to spines but are here considered hairs. Otherwise as in male.

Abdomen. .955 mm. long; longer than wide in ratio of 43 : 20; much compressed laterally, deeper than wide in ratio of 13 : 10; with no dorsal scutum; ventral scutum extending so far dorsally that the 2 sides meet on the dorsum anteriorly and diverge posteriorly; scutum and membranous regions fairly well covered by a scanty growth of short dark hair or bristles.

Epigynum. The shallow opening is slightly angular but in general is a broad oval; 2 chitinous lateral spots quite conspicuous; with a



External Anatomy of Oonopid Spiders

Figures 22–31

Figs. 22–23. *Scaphiella barroana* Gertsch; epigynum and cheliceral spine, respectively.

Figs. 24–25. *S. gertschi* sp. nov.; eyes, from above and right maxilla, respectively.

Figs. 26–27. *S. gertschi*; male palpal tarsus and epigynum, respectively.

Fig. 28. *S. williamsi* Gertsch; epigynum.

Figs. 29–30. *Stenoonops petrunkevitchi* sp. nov.; eyes, from above and male palp, respectively.

Fig. 31. *Triaeris patellaris* Bryant; epigynum.

central pyriform spot attached anteriorly and with a very small dark center (Fig. 27).

Color in alcohol. Almost identical with that of male except for the differences caused by absence of dorsal scutum.

Type locality. Male holotype from C. Z. Biological Area, C. Z., July, 1939. No male paratypes. Female allotype from C. Z. Forest Reserve, C. Z., August, 1936. Four female paratypes from the following localities: C. Z. Biological Area, June–July, 1934; July, 1943–Mar., 1944, Berlese funnel (Zetek); C. Z. Forest Reserve, C. Z., August, 1936.

SCAPHIELLA WILLIAMSI Gertsch, 1941

(Figure 28)

Female allotype. Total length 1.665 mm. Carapace .633 mm. long; .466 mm. wide opposite second coxae where it is widest; regularly rounded from opposite palps to short posterior border; .240 mm. tall and, therefore, about .52 as tall as wide; only slightly raised from PME to beginning of steep posterior declivity opposite interval between second and third coxae from which the descent is steep to posterior border; surface finely granulated along ventral border, in a moderately broad sub-marginal band and in a more conspicuous stripe up each posterolateral corner; with a sparse covering of short dark bristles.

Eyes. Six in 2 rows; in a compact group; AME lacking; posterior row occupies seven-tenths of width of carapace at posterior borders; posterior row gently procurved. Ratio of eyes ALE : PME : PLE = 3 : 2.3 : 2. All eyes nearly round. ALE separated by about one-half their radius, barely separated from PLE and from PME by about one-third of the diameter of the latter. AME contiguous to one another and to PLE. Posterior row wider than anterior row in ratio of 13 : 10. Height of clypeus equal to four-thirds of the diameter of ALE.

Chelicerae. Parallel, vertical, quite prominent near base in front; basal segment .24 mm. long; apparently with a fairly prominent black tooth on each margin of obscure fang groove near medial end; fang slender and evenly curved.

Maxillae. Moderately long and slender; quite convergent with anterior ends pointed and provided with a small scopula.

Lip. Moderately well chitinized; somewhat wider than long; reaches about two-thirds the length of the maxillae.

Sternum. Scutiform; quite convex; quite strongly grooved opposite intercoxal spaces but grooves are short and each reaches only about one-fifth of width of sternum; longer than wide in ratio of

19 : 16; sternal suture moderately procurved; posterior end truncated and not extended between fourth coxae which are well separated. First coxae somewhat elongated; all others nearly globose.

Legs. 4?132. Width of first patella at "knee" .0666 mm., tibial index 14. Fourth leg missing.

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
			(All measurements in millimeters)			
1.	.377	.189	.278	.244	.230	1.318
2.	.266	.198	.266	.244	.200	1.174
3.	.333	.177	.245	.244	.200	1.199

Palpal tarsus with a small tuft of modified hairs near base on prolateral side. Trichobothria of the long slender type with short lateral branches were observed as follows: 1 dorsal near base of tibia and 2 dorsal just beyond middle of same segment; 1 dorsal near distal end of metatarsus; all legs appear to be the same in this respect. Claws: 2 set on a moderately long, transversely-grooved onychium; each appears to have 2 sets of short teeth, 1 of these is a long series while the other is short.

Spines. Apparently legs are completely devoid of true spines.

Abdomen. Considerably compressed laterally; with nearly parallel lateral sides; pedicel hardly showing from dorsal side; longer than wide in ratio of 23 : 11; 1.02 mm. long; with no dorsal scutum; ventral scutum extends far up lateral sides to dorsum; ventral scutum entire, extended to include pedicel and base of abdomen dorsal to the latter and posteriorly near to spinnerets; with a moderately broad sclerite extending as a band around base of spinnerets except the dorsal fourth of the circumference; apparently 6 spinnerets close together with anterior pair the most robust and longest; a pair of long black bristles appear to indicate the position of the reduced colulus; openings of book-lungs and tracheal spiracles moderately distinct.

Epigynum. Very simple; only a nearly circular opening with thickened chitinous spot on each lateral side and a nearly central circular spot connected to anterior border by a thin line (Fig. 28).

Color in alcohol. Essentially as described for the male by Dr. Gertsch and in both sexes in *S. barroana* (except for the absence of the dorsal scutum).

Type locality. Female allotype from the C. Z. Biological Area, C. Z., sometime between July, 1943 and March, 1944; taken in a Berlese funnel by Dr. Zetek.

Genus STENOONOPS Simon, 1891

STENOONOPS PETRUNKEVITCHI sp. nov.

(Figures 29–30)

I consider this species congeneric with and closely related to *S. nitens* Bryant from St. Croix, Virgin Islands.

Male holotype. Total length 1.34 mm. (cephalothorax and abdomen detached but otherwise in good condition). Carapace .60 mm. long; .422 mm. wide opposite second coxae where it is widest; considerably narrowed opposite palps and at posterior border; .20 mm. tall and, therefore, nearly half as tall as wide; rises slightly just behind PME and then remains nearly level to opposite third coxae from which place the steep posterior declivity descends to posterior border; surface well covered by numerous minute pits or tubercles but less conspicuously so than in *S. nitens* Bryant; without a median thoracic groove; quite strongly convex through central region with lateral sides steeply sloping.

Eyes. Six in 2 rows; arranged in a compact group; AME lacking; eye group occupies about seven-tenths of the width of carapace at level of posterior row; posterior row gently recurved, measured by posterior borders. Ratio of eyes ALE : PME : PLE = 6 : 5 : 4.4. All eyes somewhat oval; long axes used to determine ratios. ALE separated from one another by about one-sixth of their length, contiguous to PLE and barely separated from PME. PME contiguous throughout median borders, tangent to PLE. Posterior row wider than anterior row in ratio of 13 : 11. Black pigment concentrated in ocular area. Height of clypeus equal to about one-half of width of ALE; clypeus somewhat convex and with a transverse row of 4 long stiff bristles (Fig. 29).

Chelicerae. Vertical, somewhat divergent, outer margins essentially parallel. Basal segment .18 mm. long, pointed distally, with a well developed scopula of stiff bristles along obscure fang groove which is unarmed. Fang slender and evenly curved. Without basal boss.

Maxillae. Long, slender, extending almost to tip of chelicerae, somewhat divergent; strongly ridged along outer border; with palps inserted into basal third.

Lip. Much broader at base than at distal border; wider at base than long in ratio of about 4 : 3; extends to about the beginning of last third of length of maxillae. Sternal suture either very obscure or lacking altogether.

Sternum. Longer than wide in ratio of about 4 : 3; moderately convex; strongly lobed opposite coxae, with well defined grooves opposite intercoxal intervals; widest between second coxae but nearly as wide between first coxae; strongly chitinized area extends between coxae in well defined bridges; posterior end a blunt point between fourth coxae which are separated by nearly three-halves of their width. All coxae subglobose.

Legs. 4123. Width of first patella at "knee" .0444 mm., tibial index 10. Width of fourth patella at "knee" .0666 mm., tibial index 12.

(All measurements in millimeters)

	Femora	*Patellae*	*Tibiae*	*Metatarsi*	*Tarsi*	*Totals*
1.	.377	.200	.260	.210	.170	1.217
2.	.333	.190	.244	.200	.150	1.117
3.	.288	.130	.200	.180	.140	.938
4.	.311	.200	.320	.240	.200	1.271
Palp	.111	.088	.085	...	.144	.428

Femora raised dorsally and somewhat deepened near proximal end. Apparently a single long "feathery" dorsal trichobothrium on palpal tibia; also on first leg there is a pair of the long "feathery" dorsal trichobothria at beginning of last third and a single dorsal one near proximal end; also a single dorsal distal one on metatarsus. Also on first leg a curious type of "hair" grouped near distal end of tarsus but also very similar if not identical "hairs" occur on other segments among numerous spiniform bristles. The special kinds of "hairs" are short, broad and appear to have a close spiral ridge or corrugation extending from near base to tip (viewed from certain angles); when viewed from other angles the "hairs" seem to have a series of short oblique ridges on one side only and to be smooth on the other side. These "hairs" should be carefully studied to reveal their structure and significance more clearly. The claws are 2 and each seems to be simple with a heavy terminal tooth together with a single series of about 4 or 5 smaller teeth more proximal in position.

Spines. Probably to be considered devoid of true spines, although many of the hairs are spiniform.

Palp. Short, simple; with a series of curiously modified hairs chiefly on dorsal surface at distal end of tibia and extending along dorsal surface of tarsus as a distinct pad. Each hair is generally clavate in form and somewhat "feathery" in general appearance as revealed under high magnification; these hairs are somewhat similar to the special "hairs" already noted on pedal tarsi and elsewhere. Tarsus with a moderately inflated, ovoid bulb terminating in an extension which appears to be divided distally into a sinuous hook and a nearly straight spine, but finer details are difficult to determine (Fig. 30).

Abdomen. Ovoid, widest in middle. Soft and completely devoid of scuta or specially chitinized regions; surface smooth and shining, with a slight iridescence; with a sparse covering of short, dark, mostly recurved hairs; openings of spiracles and book-lungs very obscure. Spinnerets presumably 6, closely grouped so that middle ones are hidden in holotype; posterior spinnerets longest but all are of moderate length. No colulus observed.

Color in alcohol. Carapace a clear brownish-yellow. Appendages and sternum somewhat lighter. Abdomen a yellowish-white with slight iridescence. Just in front of base of spinnerets there is a pair of dark spots separated by about their diameter; each spot is composed of 3 smaller spots. Miss Bryant noted similar spots ('42) in *S. nitens* and thought they were indications of a pair of subhypodermal sacs.

Type locality. Male holotype from C. Z. Biological Area, C. Z., July, 1938; collected by Prof. A. Petrunkevitch and loaned to me for study. One male paratype from the same locality, June October, 1946. Berlese funnel (Zetek).

Genus TRIAERIS Simon, 1891

TRIAERIS PATELLARIS Bryant, 1940

(Figure 31)

Described from Cuba where it was collected by Dr. P. J. Darlington of the staff of the Museum of Comparative Zoölogy. Dr. W. J. Gertsch first identified one of my specimens and I have confirmed this by a comparison with the holotype and paratypes. Only females are known. Epigynum as shown in Figure 31.

Collection records: C. Z. Biological Area, C. Z., summer of 1938 (Petrunkevitch); July, 1943–March, 1944; June–October, 1946; eleven specimens collected 1943–1946 in a Berlese funnel by Dr. James Zetek.

Addendum. The new species recognized in this paper include those named in honor of individuals as follows: *Oonopoides bryantae,* sp. nov. in honor of Miss Elizabeth B. Bryant, devoted student of spiders and curator of the extensive collection of these animals in the Museum of Comparative Zoölogy at Harvard College; *Oonops donaldi* sp. nov. in honor of my son, Dr. Donald H. Chickering, who was my close companion and assistant during two very pleasant summers in Panama; *Oonops zeteki* sp. nov. in honor of Dr. James Zetek, for many years the devoted caretaker of the C. Z. Biological Area, C. Z. and untiringly coöperative in helping me to plan my several summers' field work in Panama; *Scaphiella gertschi* sp. nov. in honor of Dr. W. J. Gertsch, American Museum of Natural History, New York City, able student of spiders and helpful consultant; *Stenoonops petrunkevitchi* sp. nov. in honor of Professor Emeritus Alexander Petrunkevitch, Yale University, distinguished arachnologist and for nearly forty years a teacher, close friend, and always a stimulating influence.

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THE PHYLLOPHAGA OF HISPANIOLA
(COLEOPTERA: SCARABAEIDAE)

Milton W. Sanderson
Illinois Natural History Survey
Urbana, Illinois

With Six Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
August, 1951

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No. 6 — *The Phyllophaga of Hispaniola (Coleoptera: Scarabaeidae)*

Milton W. Sanderson

This revisional study is based primarily upon the collection in the Museum of Comparative Zoölogy, Harvard University, and is chiefly a result of collections made by Dr. P. J. Darlington in the Dominican Republic. Additional material has been studied in the collections of the U. S. National Museum, American Museum of Natural History, University of Michigan, G. N. Wolcott, Mark Robinson, and the Illinois Natural History Survey.

SELECTION OF A GENERIC NAME

Several generic names have been used for this group of beetles in the West Indies including *Phyllophaga* Harris (1826, p. 7), *Ancylonycha* Dejean (1833, p. 160), *Lachnosterna* Hope (1837, p. 100), and *Phytalus* Erichson (1847, p. 658). Saylor (1942), on the basis of adult characters, distinguished most of the West Indian species from the continental American species under the new genus *Cnemarachis*, and designated the Puerto Rican *Phyllophaga vandinei* Smyth (1917, p. 65, 68) as genotype. The distinctiveness of this new genus as a group especially differing from the United States species was supported by Böving (1942) who studied the larvae of eight species from Cuba and Puerto Rico. The subgenus *Abcrana* was described by Saylor (1942) to include only its genotype, *Phyllophaga crinitissima* More (1923, p. 105) from Puerto Rico. *Clemora* Saylor (1942) was also described with *Phytalus smithi* Arrow (1912, p. 458) from Trinidad and Barbados, as genotype, and including *Phytalus apicalis* Blanchard (1850, p. 131) from Puerto Rico. Böving studied larval material of *Clemora smithi* from Jamaica and Barbados and also larvae of what he thought might be *Clemora apicalis* from Haiti. On the basis of these studies, he agreed with Saylor as to its generic distinctiveness and also as a genus distinct from continental *Phyllophaga*.

In the analysis of the Hispaniolan species and a comparison with many other West Indian and American species included under these names, two important considerations became apparent. The first was to decide if the West Indian components of this group were generically distinct from the continental species as contended by Saylor and Böving. *Cnemarachis* was distinguished from *Phyllophaga* by usually having the middle and posterior tibiae each with one or more large spines or with edges of tibia serrate and by having the middle or posterior tibia usually with an incomplete transverse carina. *Clemora* possessed the same features but had the tarsal claw cleft, as in fig. 1, instead of having a median or submedian tooth, as in fig. 2. The subgenus *Abcrana* differed chiefly from *Cnemarachis sensu stricto* by having the tarsal claw of the male entirely without teeth.

Both cleft and normally toothed claws were found among the Hispaniolan species, and one species, *canoa*, has a type of claw intermediate between the other types. This condition appears to indicate that on the basis of adult characters, *Clemora* cannot be considered as differing generically from *Cnemarachis*. No Hispaniolan species was found having the tarsal claws entirely without teeth. However, *panorpa* Sanderson (1950) from Florida has no distinct tooth on the tarsal claw but is very closely related otherwise to another Florida species, *elongata* Linell, which possesses a well developed tooth. Although these Florida species are not closely related to those of Hispaniola, it would appear by this comparison that the simple claws of *Abcrana* scarcely justify its distinction even as a subgenus. The structure of the male and female genitalia are basically the same in the West Indian and continental species, and no features were found in them to support the genera proposed in this group.

Among three males of *fossoria*, described here from Hispaniola, the usual tibial spines or serrations, characteristic of nearly all West Indian species, were entirely absent on a tibia of one individual and slightly developed on the remaining tibiae and on those of the other males. With the disappearance of these adult differences for separating the West Indian species from those of continental America, only the larval characters as shown by Böving would seem to distinguish *Cnemarachis* and *Clemora* from *Phyllophaga*. However, Böving studied larvae of but eight of the approximately 100 known West Indian species and based his conclusions upon certain features not known to occur in the United States species. He also considered the independent decision by Saylor of the distinctiveness of the West Indian forms. I believe that considering the evidence available, *Cnemarachis* should be reduced to a subgenus of *Phyllophaga* since as a whole it is a group fairly distinct but whose position may be clarified eventually with the detailed study of additional species including more larval representatives.

A second consideration in this report was to determine the first valid generic name to be used for this genus. There has been much discussion in the literature, especially by Arrow (1944, 1948), concerning the proper choice between *Lachnosterna* and *Phyllophaga*, and he strongly supported the use of *Lachnosterna* by virtue of its having been described with a genotype designated. Arrow (1948) also considered *Ancylonycha* to be the valid generic name for the West Indian species with *Cnemarachis* as a synonym. Glasgow (1916) selected the North American *Melolontha hirticula* Knoch (1801, p. 79) as the genotype of *Phyllophaga,* and both Glasgow and Saylor have supported the use of *Phyllophaga* as the earliest valid name to be applied especially to the continental American species. The names *Phyllophaga* (1826) and *Ancylonycha* (1833) were unsupported by descriptions or by designated genotypes, and the name *Lachnosterna* (1837) was fully supported by a description and a type species. However, Harris included several previously described valid American species in his discussion and without having distinguished the genus by any characters, he proposed that the name *Phyllophaga* be used for those species. It appears to be debatable whether the inclusion of the names of several valid species constitutes an "indication", but until the matter can be settled by a ruling of the International Commission of Zoological Nomenclature, I propose to continue to use the name *Phyllophaga* for this large genus.

DESCRIPTION OF THE GENUS

The characters of *Phyllophaga,* as applied to most of the species of Hispaniola, may be summarized as follows: middle and posterior tibiae generally with well developed spines or serrations along the edges, and middle or posterior tibia usually with an incomplete transverse carina; tarsal claw cleft at apex, that is, with a very narrow angle between the upper and lower teeth or parts, or claw with a median or submedian ventral tooth; anterior tibia nearly always tridentate; both spurs of posterior tibia well developed, attached to apex by movable joints in both sexes; antenna 9-segmented, the club usually of three segments but occasionally with a partial or complete fourth segment; elytral punctures rather evenly spaced and not arranged in longitudinal rows.

CHRONOLOGY OF THE DESCRIBED SPECIES

The first species in this genus described from Hispaniola were *hogardi* Blanchard (1850) and *neglecta* Blanchard (1850). Burmeister (1855) included these two species as occurring in Hispaniola in his work on Lamellicorn Coleoptera and also recorded *fervida* Fabricius (1775) from St. Domingo and Jamaica. However, the species generally considered as *fervida* has been found only in the northern part of North America. Burmeister may have based his Santo Domingo record on *hogardi,* or closely related forms, since this species and *fervida* are somewhat similar in appearance. Chevrolat (1865) described and recorded *Ancylonycha patruelis* from Cuba, Guadeloupe, and "Saint-Domingue", but no species in this genus is known to occur on all three islands. His Dominican Republic individuals were described as "... petits, d'un testacé brillant, à prothorax d'un rougeâtre plus clair." Possibly these latter individuals were *audanti* Wolcott, which measures from 8 to 10 mm. in length. Representatives of what is believed to be the true *patruelis* from Cuba are about 16 mm. in length. Leng and Mutchler (1914, p. 440) recorded, under *Lachnosterna,* the four preceding species from Hispaniola in a list of West Indian Coleoptera. Moser (1918) described *major* from Santo Domingo, and *permagna* from Haiti. He stated that *major* was the species that he found in the Chevrolat collection under the name *fervida.* Wolcott (1928) was the first to give a synoptic treatment of the Haitian species known to him. He redescribed *hogardi* and *neglecta,* and described five species as new. He rejected the previous records of *fervida* and *patruelis,* and did not mention the species described by Moser. Saylor (1940) added *pseudocalcaris,* and later (1946) *romana* to the known fauna of Hispaniola.

In the present revision, the ten previously recognized species from Haiti and the Dominican Republic are redescribed, and in addition 15 new species are made known. Males of 22 species and females of 17 of the 25 species were studied. Unless otherwise stated, the types of all new species are deposited in the collection of the Museum of Comparative Zoölogy, Harvard University, and paratypes have been deposited in the collection of the Illinois Natural History Survey [I.N.H.S.]. The location of some uncommon species and types of previously described species is indicated in brackets: United States National Museum [U.S.N.M.], L. W. Saylor Collection in California Academy of Sciences [L.W.S.], University of Michigan [U. Mich.] and American Museum of Natural History [A.M.N.H.].

SECONDARY SEXUAL CHARACTERS

Since males or females only are known for certain of the Hispaniolan *Phyllophaga,* the sexes are keyed separately. The males and females are very similar in general appearance, but although the differences may be slight, the two sexes can nearly always be distinguished by the male having the last sternite transversely grooved or depressed and the female having this sternite flat or slightly convex. In a few species the antennal club of the male is longer than the club of the female. The apical tibial spurs of the male are usually more slender than those of the females, and in a few species the inner spur, which lies closest to the tarsus, is slightly to strongly angulate.

SPECIES CHARACTERS

The position of the lower tooth of the tarsal claw, the absence or presence of an inner apical elytral spine, the number and degree of development of segments in the antennal club and the spined or unspined condition of certain tarsal segments are among the most useful characters for distinguishing species. Some species have the dorsum pruinose and iridescent, others are shining. Other differences are found in the head, pygidium and the posterior tibia, especially the apical spurs.

In addition to these and other characters which will enable one to distinguish most of the species, the male and female genitalia offer excellent characters for identifying the species. The male genitalia were illustrated for the Haitian species by Wolcott, and in the present report, illustrations for the females are also given in order that unassociated individuals may be identified.

PREPARATION AND STUDY OF GENITALIA

Dried adults may be readily relaxed in a moist chamber for 24 to 48 hours and the genitalia then removed through the aperture between the pygidium and last sternite with the aid of a hooked needle. The structures are then cleared in cold 10% KOH or caustic soda for 24 to 48 hours after which they are removed to distilled water for about an equal period. Following the washing, the genitalia may be placed in a dish of alcohol for dissecting away extraneous membranous or adhering structures and for teasing out the aedeagus (copulatory sac or sheath) which often is invaginated inside the heavily sclerotized clasper of the male genitalia. The structures on the aedeagus may be slightly variable, especially in the number and arrangement of spines. The aedeagus may be found to be more evaginated in some individuals than in others, and the relative position of structures on the sac may therefore be different among males of the same species. The female genitalia consist primarily of the central single or paired pubic process and the two more basal genital plates. The male and female genitalia may be easily preserved in small glycerine vials attached to the pin with the adult.

Key to Species

1. Last abdominal sternite usually distinctly transversely grooved or depressed; genitalia consisting of a long curved semi-tubular basal structure with symmetrical claspers attached perpendicularly to its apex (males) 2
   Last abdominal sternite flat or slightly convex; genitalia consisting primarily of a pair of separated or joined plates, and a single or paired apical pubic processes, as in figs. 60 and 75 (females) 23
2. Tarsal claw (fig. 1) deeply and narrowly cleft; each clasper (fig. 5) with a group of long stiff hairs on side in region of upper margin .... *fossoria*
   Tarsal claw (fig. 2) with a median or basal tooth, the angle wide between upper and lower tooth; clasper without hairs .. 3
3. Inner apical angle of elytron (fig. 3) distinctly spinose; first two to four posterior tarsal segments (fig. 4) spinose on apical angles 4
   Inner apical angle of elytron without distinct spine; not more than one posterior tarsal segment spinose at apex 7
4. Length 27 mm.; pronotum shining, elytra almost entirely pruinose and with scattered inconspicuous short erect yellowish hairs becoming longer toward suture .... *permagna*
   Length 17–25 mm.; body above uniformly shining or pruinose; elytra without hairs 5
5. Elytron usually entirely glabrous and shining; claspers (fig. 11) completely united apically .... *hogardi*
   Elytron, except humeral swelling, uniformly pruinose; claspers separated at apexes as in figs. 13 and 15 6
6. Inner posterior tibial spur twice as long as outer spur and sinuately curved; ridge of apical swelling on clasper (fig. 13), when viewed caudally, angulate laterally, extending beyond margin of ventral triangular structure and incomplete at middle .... *romana*
   Inner posterior tibial spur less than twice as long as outer spur and simply curved; side of apical swelling on clasper (fig. 15) only slightly curved, not extending over edge of lower triangular structure and complete .... *leptospica*
7. Antennal club with four complete segments .... *garrota*
   Antennal club with not more than three complete segments .. 8
8. Sixth antennal segment forming a part of club and one-fourth to nearly one-half length of club .... *probapora*
   Antennal club 3-segmented, the sixth segment not forming part of club 9
9. Clypeo-frontal suture raised into a sharp carina .... *costura*
   Clypeo-frontal suture never raised, usually impressed 10

10. First posterior tarsal segment produced into a spine on inside of apical margin, the spine about one-third length of small tibial spur . . . . *espina*

First posterior tarsal segment slightly or not at all produced on apical margin 11

11. Margin of posterior tibia (fig. 25) suddenly elevated near short spur to form a pseudospur . . . . *pseudocalcaris*

Margin of posterior tibia at most evenly elevated 12

12. Tarsal segments, especially anterior ones, densely clothed below with long yellow hairs . . . . *minutissima*

Tarsal segments at most with about 10 setae on each lower surface before apex 13

13. Inner spur of posterior tibia (fig. 30) distinctly angled on outer margin and enlarged toward apex . . . . *esquinada*

Tibial spurs slender and nearly straight 14

14. Posterior angles of pronotum emarginate . . . . *recorta*

Posterior angles of pronotum rounded or angulate, not emarginate 15

15. Aedeagus with a long trilobed dorsal process (as in figs. 36 and 37) arising on dorsal part of apex of sclerotized tube; lateral margins of pronotum generally crenulate at least in part 16

Aedeagus with a simple sclerotized tube which is without large dorsal process; lateral margins of pronotum generally smooth 18

16. Body above pruinose; lateral margin of pronotum crenulate throughout its length; lateral lobes of aedeagal process much shorter than median lobe (as in figs. 37 and 41) 17

Body above shining, not pruinose; lateral margin of pronotum crenulate only in anterior one-half to three-fifths; median and lateral lobes of aedeagal process (fig. 36) nearly subequal in length . . . . *kenscoffi*

17. Antennal club longer than combined length of 5 preceding segments; lateral lobes of aedeagal process (fig. 37) nearly vertical and evenly rounded at apex . . . . *neglecta*

Antennal club subequal to combined length of 5 preceding segments; apexes of lateral lobes of aedeagal processes (figs. 41 and 43) together flattened and divided, each part tapering to a sharp angle . . . . *mali*

18. Body above entirely glabrous and shining, not pruinose; clasper suddenly raised at apex into beak; aedeagus with 4 slender spines . . . . *audanti*

Body above pruinose iridescent 19

19. Antennal club distinctly longer than preceding 5 segments combined, more than twice as long as clypeus at middle 20

Antennal club distinctly shorter than preceding 5 segments and much less than twice as long as clypeus at middle 21

20. Surface of pygidium even, with a few large shallow punctures; membrane of aedeagus (fig. 46) with 3 or 4 spines; upper edge of clasper near dorsal margin with a very small triangular projection on each side........ *cartaba*

Surface of pygidium very uneven, the punctures shallow and separated by once or twice their diameters; membrane of aedeagus with 13 spines; upper edge of clasper (fig. 48) without projections........ *panicula*

21. Front with a sharp longitudinal impression which produces a bituberculate appearance; upper margin of clasper (fig. 52) slightly emarginate at about apical two-fifths; aedeagus with two slender processes........ *imprima*

Front not more than slightly depressed at middle; upper margin of clasper convex (as in figs. 49 and 56)........ 22

22. Length 8.5 mm.; clypeus slightly emarginate on anterior margin; clasper (fig. 49) with a very small triangular projection on outer apical margin........ *latiungula*

Length 13.5–15 mm.; clypeus distinctly and deeply emarginate; apex of each clasper (fig. 56) with a strong triangular projection........ *mella*

23. Tarsal claw cleft (fig. 57) producing a very narrow angle between upper and lower teeth........ 24

Tarsal claw more simply toothed with wider angle between upper and lower teeth (as in fig. 2)........ 25

24. Clypeus very distinctly emarginate; front with a deep longitudinal groove close to and parallel to each eye; color dark reddish brown, shining........ *canoa*

Clypeus very slightly emarginate, almost truncate; front without groove near each eye; elytra yellow, pruinose, head and pronotum darker than elytra........ *aliada*

25. Inner apical angle of elytron prolonged into a slender spine (as in fig. 3)........ 26

Inner apical angle not prolonged........ 29

26. First and second posterior tarsal segments prolonged on inner and outer margins at apexes; apical margin of posterior tibia with 18 to 20 spinules; lateral margin of pronotum entirely crenulate........ *permagna*

Second segment prolonged at apex only on inner margin; apical margin of posterior tibia with 22–46 spinules; lateral margin of pronotum at most crenulate in anterior half........ 27

27. Body above generally smooth and shining, not distinctly pruinose; apex of posterior tibia with 37–46 spinules; apex of pubic process (fig. 61) deeply and evenly emarginate........ *hogardi*

Body above dull, pruinose; apex of posterior tibia with 22 to 25 spinules; pubic process unevenly emarginate or straight at apex........ 28

28. Pubic process (fig. 63) sinuately emarginate at middle of posterior margin .... *romana*
Pubic process (fig. 64) nearly straight on posterior margin .... *leptospica*

29. Apical margin of posterior tibia (fig. 25) suddenly produced into a triangular tooth near outer tibial spur .... *pseudocalcaris*
Apical margin straight or slightly concave 30

30. Apex of pygidium (fig. 66) produced into an upturned triangular process .... *kenscoffi*
Apex of pygidium rounded or truncate 31

31. Pygidium with a large dark median area which is strongly longitudinally wrinkled; punctures on median area indistinct .... *latiungula*
Pygidium uniformly colored or slightly darker at middle, the punctures distinct; surface not wrinkled 32

32. Length 6–10 mm.; lower tooth of tarsal claw close to base, very short, about one-half length of upper tooth 33
Length 13.5–20 mm.; lower tooth of claw median, strong, about as long as upper tooth 35

33. Body above distinctly pruinose; pygidium very irregularly and shallowly punctured, the surface brown except for narrowly pruinose margins; head very roughly punctured, the front longitudinally impressed .... *cartaba*
Body above shining, not pruinose; pygidium strongly and uniformly punctured; head evenly punctured and not distinctly longitudinally impressed 34

34. Sutural and lateral margins of elytra very narrowly dark brown to black; remainder of elytra pale brown .... *minutissima*
Elytra uniformly pale brown .... *audanti*

35. Each posterior angle of pronotum distinctly emarginate; genitalia (fig. 73) with a completely fused triangular plate below base of pubic process .... *recorta*
Each posterior angle of pronotum rounded or rectangular; genitalia without fused triangular plate below base of pubic process 36

36. Posterior tibia with about 15 apical marginal spines; genitalia (fig. 74) with a slender curved process arising near base of each lateral plate .... *mella*
Posterior tibia with about 30 apical marginal spines; genitalia without process near base of lateral plate 37

37. Median sclerotized area of pubic process (fig. 75) very long, reaching about the middle of the plates .... *neglecta*
Median sclerotized area short and not reaching middle of plates as in figs. 76 and 77 38

38. Anterior and posterior margins of median sclerotized area of pubic process (fig. 76) parallel; inner apical angle of each plate conspicuously prolonged; clypeo-frontal suture deeply and strongly triangularly impressed on sides .... *barrosa*
Median sclerotized area of pubic process (fig. 77) expanded,

nearly twice as wide as at sides; apex of each plate truncate and at nearly a right angle to inner margin; clypeo-frontal suture very shallowly impressed on sides.......................*mali*

PHYLLOPHAGA FOSSORIA n. sp.

This species, together with *aliada* n. sp. and *canoa* n. sp., has a narrower angle between the upper and lower teeth of the tarsal claw than found in other Hispaniolan species. This type of claw (fig. 1) has often been referred to as "cleft."

Male. Length 12.5–14 mm.; width 5.5–6 mm. Color of elytra reddish yellow, the suture darker and with color spreading over part of declivity near apex. Pronotum with central half darker than elytra. Front of head darker than pronotum; clypeus lighter than front. Antennal club 3-segmented, nearly equal to entire stem. Clypeus straight on sides, angles rounded and front margin nearly truncate; punctures very fine and scattered; front with shallow punctures larger than those on clypeus; punctures on clypeus and head bearing hairs, some of which on front are nearly equal to one-half the pronotal length. Sides of pronotum irregular, especially when viewed from the sides, convergent from the middle to base where it is wider than at apex; surface uneven, finely and irregularly punctured. Elytra gradually inflated behind, as finely but more deeply and irregularly punctured than pronotum, the punctures bearing short hairs; hairs longer toward base, on sides and apex of elytron. Basal swelling of anterior tibia very inconspicuous. Tarsal claw as in fig. 1, the upper tooth longer than the lower. Spurs of posterior tibia slender, nearly straight; outer margin of tibia at apex with 10–18 spinules. Posterior tibiae with or without spines. Metasternum finely and closely punctured with long hairs some of which are longer than width of posterior femur. Pygidium strongly curved ventrad before the apex and with a few hairs in the shallow punctures. Abdomen depressed and with a few short stout hairs on middle of each sternite. Genitalia, (figs. 5 and 6) with the sides of claspers strongly curved at apex, each bearing a group of short hairs on side.

The tibial spines or serrations, so characteristic of many West Indian *Phyllophaga*, are completely absent on the posterior tibia of one male and only slightly developed on the remaining tibiae, and on the tibiae of the other males.

Holotype male, Dominican Republic: Constanza to Valle Nuevo, 3000–7000 feet, August 1938 (Darlington.)

1 ♂ paratype, Dominican Republic: Loma Rucilla and mountains north, 5000–8000 feet, June 1938 (Darlington).

1 ♂ paratype, Dominican Republic: vicinity of Valle Nuevo, 6000 feet, cloudforest, August 1938 (Darlington). [I.N.H.S.]

This species appears to be closely related only to *aliada* in the Hispaniolan fauna. In addition to the differences indicated in the description of *aliada,* the elytral hairs of *fossoria* are distinctly more numerous and longer, especially on the sides. The sides of the pronotum are also much more uneven than in *aliada.* The aedeagus is more expanded in the type of *fossoria,* as illustrated, than in the paratypes.

PHYLLOPHAGA PERMAGNA (Moser)

Lachnosterna permagna Moser (1918, p. 57)

Two individuals, agreeing closely with Moser's description of *permagna,* have been studied, and although the description does not mention the spinous elytral apex, it is believed that the species has been correctly identified.

Male. Length 27 mm.; width 13–14 mm. Color of pronotum deep reddish, the head scarcely darker; elytron almost entirely pruinose except for a narrow shining brown lateral area extending from the humerus to about middle of elytron on margin. Antennal club 3-segmented, equal to 5 preceding segments combined, about one-fourth length of clypeus at middle. Clypeus rounded at base before eyes and on sides to the distinctly emarginate apex; surface depressed, central portion at base raised, and with shallow, rather closely placed irregular punctures; punctures on vertex similar to those on clypeus and without hairs. Pronotum with shallow and irregular punctures, the sides with extensive areas without punctures; lateral margins of pronotum slightly uneven, a little divergent from middle to the rectangular basal angles, and strongly convergent to apex which is one-half the basal width. Anterior tibia distinctly tridentate. Tarsal claw with a very strong lower tooth, the upper and lower teeth of nearly equal length. Posterior tibia with inner spur long and narrow, the apical one-third rather suddenly curved; outer spur slender, pointed, a little more than one-half the length of inner spur; outer margin of tibia at apex with 9–10 spinules. First posterior tarsal segment strongly produced on inner and outer margins at apex; second segment strongly produced on inside and outside, the outer tooth shorter; third and fourth segments produced only on one side, the tooth of fourth segment shorter than that of third. Metasternum very finely punctured, the hairs not so long as width of posterior femur. Elytra much more finely punctured than pronotum, punctures regular in distribution; sutural apex (fig. 3) produced into a spine. Pygidium nearly flat, glabrous, very finely and shallowly punctured. Genitalia (figs. 7, 8 and 9) with the clasper narrowed, and the claspers not joined at apexes.

Female. Length 27 mm.; width 13 mm. Pronotum very irregularly punctured. Pubic process (fig. 62) deeply emarginate, the median sclerotized region longer than process at apex. Color similar to male except lateral half of each elytron shining reddish-brown; 3-segmented antennal club equal to 5 preceding segments combined and equal to length of clypeus at middle; outer margin of posterior tibia with 18–20 spinules; first and second posterior tarsal segments strongly produced on inner and outer margins at apexes, third segment produced only on one side.

RECORDS: Haiti: Port-au-Prince [types in Berlin Museum]
1 ♀ Haiti: La Visite and vicinity, La Selle Range, 5000–7000 feet, September 16–23, 1934 (Darlington) [M.C.Z.]
1 ♂ Ouest Haiti: Kenscoff, May 3, 1937 (Roys) [U. Mich.]

This is the largest species in the *hogardi* group, and in addition to its larger size it may be distinguished by having elytral hairs. There are numerous differences in the genitalia of both sexes, as shown in the illustrations, between this species and others in this group. The male and female were described by Moser but the number of individuals of each was not indicated in his description.

PHYLLOPHAGA HOGARDI (Blanchard)

Ancylonycha hogardi Blanchard (1850, p. 137)
Ancylonycha hogardi Blanchard. Burmeister (1855, p. 337)
Phyllophaga hogardi (Blanchard). Wolcott (1928, p. 26)

This is the most widely distributed and abundant species of *Phyllophaga* found thus far in Hispaniola and with *romana* Saylor, *leptospica* n. sp., and *permagna* Moser forms a group characterized by the presence of a spine on the sutural apex of each elytron. These species also have the first three posterior tarsal segments spinose on at least the inner apical angles as in fig. 4.

Male. Length 19–23 mm. Width 9–12 mm. Color varying from reddish to deep brown. Body robust and usually strongly shining above with the punctures fine and moderately close. Antennal club 3-segmented, short and subequal to 4 preceding segments combined, equal in length to clypeus at middle. Head very closely punctured and without hairs. Inner spur of posterior tibia four to five times longer than wide and evenly curved. Lower tooth of tarsal claw strong, median, about equal in length to upper tooth. Genitalia (figs. 10 and 11) with the apexes of claspers united, strongly narrowed in lateral view.

Female. Length 20–25 mm. Width 11–13 mm. Antennal club shorter than that of male, equal to about three-fourths length of clypeus at middle. Pubic process (fig. 61) somewhat similar to other species in this group, the apical emargination partially filled with a membrane.

A male from Puerto Plata, Dominican Republic, has both antennae 8-segmented, but another male from the same locality has the antennae normally 9-segmented.

RECORDS: Haiti: Petionville, Port-au-Prince, February to June, September and October.
Dominican Republic: Santiago, Santo Domingo, Puerto Plata, Ciudad Trujillo, February, April to September, November.

Both sexes are generally separated from the other species in this group by their uniformly shining upper surfaces. The male claspers are united at their apexes, the other species having them separated. The pubic process of the female differs especially from that of the other species of the group by being evenly emarginate at the apex, the emargination with a short membrane at its base.

PHYLLOPHAGA ROMANA (Saylor)

Cnemarachis romana Saylor (1946, p. 1)

Male. Length 17 mm.; width 8.5 mm. Closely related to *hogardi* Blanchard but a little shorter, body more parallel, and distinctly pruinose above. Claspers (figs. 12 and 13) not united at apexes, as in *hogardi*, but narrowly separated; apex of each clasper with a broad overhanging ridge or raised portion, the inner edge incompletely carinate when viewed caudally. Inner posterior tibial spur slender and sinuately curved, not evenly curved as in *hogardi*.

Female. Length 19 mm.; width 9 mm. Pubic process (fig. 63) sinuate on posterior margin.

RECORDS: Dominican Republic: Moca, April 1928 (Russo).
Holotype male and female [U.S.N.M.]
3 ♂, 1 ♀ Dominican Republic: La Roma, July [L.W.S.]
1 ♂, 1 ♀ Dominican Republic: San Domingo (Bibby) [I.N.H.S.]

PHYLLOPHAGA LEPTOSPICA n. sp.

Male. Length 19 mm.; width 10 mm. Belonging to the *hogardi* group on the basis of the spinose inner elytral apex. Body almost entirely pruinose above. Closely related to *romana* Saylor, the two species having the claspers separated at apexes, and not united as in *hogardi* Blanchard; clasper of *leptospica*, when viewed laterally (fig. 14) with the dorsal and ventral sides nearly parallel in apical half; when viewed caudally (fig. 15), ridge of apical swelling on each clasper complete and not broken as in *romana* (fig. 13); swelling of *leptospica* much narrower than in *romana.*

Female. Length 20 mm.; width 9.5 mm. Pubic process (fig. 64) straight on posterior margin, not sinuate as in *romana.*

Holotype male, "Hayti" (Uhler).

Allotype female, same data.

The pubic process of *leptospica* is probably normally provided with several hairs at each end of the posterior margin. These were absent in the imperfect female studied.

PHYLLOPHAGA GARROTA n. sp.

Male. Length 21 mm.; width, 10 mm. Color, yellowish-brown, pronotum and head slightly reddish; body shining above and entirely glabrous. Antennal club curved laterad with four complete segments which are longer than entire stem of antenna; fifth segment about twice as wide as long. Clypeus less than twice as wide as long, almost flat, slightly emarginate at apex, shallowly, not closely punctured but with smooth nearly punctureless median area; head with wider inner spaces between punctures than clypeus; head and clypeus without hairs. Sides of pronotum subangulately rounded, the posterior angles completely absent; anterior angles almost obsolete. Surface of pronotum with fine shallow punctures irregularly and rather widely placed, generally less closely than those on head; sides of prothorax below pronotal margins with long thickly placed hairs extending dorsad, some of which appear very conspicuous between pronotum and base of elytra. Anterior tibia bidentate, basal swelling almost completely obsolete. Tarsal claw with a small median tooth equal to about one-third the length of upper tooth. Elytra gradually inflated behind, very irregularly and rather closely punctured, the punctures separated by approximately their own widths. Spurs of posterior tibia slender, evenly curved; outer margins of tibiae at apexes with 16 and 17 spinules. Metasternum very finely and closely punctured, the hairs fully twice as long as the width of posterior femur. Pygidium strongly curved, shallowly and irregularly punctured and glabrous. Abdomen nearly glabrous, evenly convex and with a few very fine punctures; last sternite flat, more coarsely punctured than preceding sternites. Genitalia (fig. 16) with apexes of claspers separated, each with a conspicuous lateral angulation; aedeagus (fig. 17) tubular and with the internal membranous sac bearing a single very small spine, the spine with a secondary basal swelling.

Holotype male, Dominican Republic: Loma Rucilla and mountains north, 5000–8000 feet, June 1938 (Darlington).

This is the only known Hispaniolan species with four complete segments in the antennal club instead of the usual three. The genitalia somewhat resemble that of *romana* Saylor and *leptospica* n. sp., but the apical swelling of the clasper is more pronounced than in those species.

PHYLLOPHAGA PROBAPORRA n. sp.

Male. Length 14 mm.; width 6.5 mm. Color dark chocolate brown, slightly pruinose and iridescent, head a little darker than pronotum and elytra. Antennal club with 3 complete segments, the sixth segment also forming a part of club but only one-fourth to less than one-half its length; club fully equal in length to entire stem. Head at most slightly tumid; clypeus with large regular punctures separated by about their own widths; punctures of front about same size but very irregularly placed and somewhat confused in median area near suture. Pronotum widest at middle, posterior angles broadly rounded; anterior margin straight, three-fourths as wide as greatest pronotal width; disc with shallow and rather widely scattered punctures and a nearly punctureless space in median basal region. Anterior tibia tridentate. Tarsal claw slender and with a small basal tooth not more than one-third length of upper tooth. Elytra unevenly but much more closely punctured than pronotum. Posterior tibial spurs nearly straight and slender; apex of tibia with 14–17 spinules. Metasternum thickly covered with long yellow hairs, some of which are nearly twice as long as width of posterior femur. Pygidium rather strongly convex, almost entirely smooth and shining and with scattered shallow punctures. Abdomen in central region very smooth and shining. Genitalia (fig. 18) with claspers convergent, each apex with a small projection above; aedeagus (fig. 19) tubular, and without processes.

Holotype, male, Dominican Republic: Loma Rucilla and mountains north, 5000–8000 feet, June 1938 (Darlington).

3♂ paratypes, same data [1♂ in I.N.H.S.].

1♂ paratype, Dominican Republic: foothills Cordillera Central south of Santiago, June 1938 (Darlington) [I.N.H.S.].

This species resembles *costura* n. sp. but differs by having the claspers convergent instead of divergent and also differs in details of the apexes of claspers. The sixth segment of the antenna forms a part of antennal club in this species, but in *costura* the club is 3-segmented only.

PHYLLOPHAGA COSTURA n. sp.

Male. Length 14–16 mm.; width 7–9 mm. Color dark chocolate brown, head and pronotum darker brown than elytra. Dorsum entirely dull, pronotum pruinose. Antennal club 3-segmented, equal in length to stem. Clypeus and front tumid, shallowly and moderately closely punctured, slightly emarginate at apex; clypeo-frontal suture raised for its entire length into a distinct carina. Pronotum widest behind middle, posterior angles almost completely absent; anterior angles distinct, width at apex about two-thirds greatest pronotal width; surface with fine shallow scattered punctures; sides and posterior region of pronotum with a few long yellowish hairs on disc and many yellow hairs arising from lower lateral and posterior margins. Anterior tibia tridentate. Tarsal claw with a triangular median lower tooth which is about one-half length of upper tooth. Elytra generally more closely punctured than pronotum and with a few scattered yellow hairs in basal one-third and along the sides; some hairs equal in length to clypeus. Posterior tibial spurs straight on their inner margins, each about equal in width to basal region of first posterior tarsal segment; apical tibial margin with 18 spinules. Metasternum with a thick covering of long yellow hairs which are about twice the width of posterior femur. Pygidium nearly glabrous, convex and with scattered shallow punctures. Abdomen evenly curved, almost without punctures in central area. Genitalia (fig. 20) with claspers divergent, the side margin shallowly emarginate; aedeagus (fig. 21) tubular and without processes on membranous lobe.

Holotype male, Dominican Republic: Loma Rucilla and mountains north, 5000–8000 feet, June 1938 (Darlington).

1♂ paratype, same data [I.N.H.S.].

Closely related to *probaporra* n. sp., this species differs from it and all other Hispaniolan species by having the clypeo-frontal suture raised into a distinct carina.

PHYLLOPHAGA ESPINA n. sp.

Male. Length 15–16 mm.; width 7.5 mm. Color reddish-brown; pronotum in part shining, elytra pruinose, slightly iridescent; head and pronotum darker than elytra. Antennal club 3-segmented, equal in length to 5 preceding segments combined. Clypeus with anterior margin distinctly emarginate and rather strongly reflexed; surface of clypeus and head unevenly punctured, the punctures generally separated by one or more times their diameters; median area of clypeus nearly smooth. Pronotum widest at middle, posterior angles broadly rounded; anterior margin straight, about three-fourths greatest width of pronotum; surface shallowly punctured, the punctures separated by one to several times their diameters. Anterior tibia tridentate. Tarsal claw with a median lower tooth equal to about one-half to two-thirds length of upper tooth. Elytra punctured as on pronotum; surface with many erect golden hairs some of which are nearly equal in length to scutellum. Posterior tibial spurs very slender; apex of tibia with 11–12 spinules; first posterior tarsal segment with a long apical spine near the tibial spurs. Metasternum very finely and closely punctured and clothed with yellow hairs which appear to be less than width of posterior femur. Pygidium coarsely, irregularly punctured. Central area of abdomen shining and distinctly although not closely punctured. Genitalia (figs. 22 and 23) having the upper margin of clasper at apex beak-shaped and strongly extended; sclerotized tube of aedeagus greatly expanded apically; dorsal margin ventrally curved, giving rise to a pair of long slender caudally curved processes, each process completely bifid; membrane of aedeagus with a row of long spinules around margin below curved processes.

Holotype male, Dominican Republic: foothills Cordillera Central south of Santiago, June 1938 (Darlington).

1♂ paratype, same data [I.N.H.S.].

The long elytral hairs, the spinose first posterior tarsal segment, and the longer upper process of each clasper will easily distinguish this species from *mella* n. sp. which it closely resembles.

PHYLLOPHAGA PSEUDOCALCARIS Saylor

Phyllophaga pseudocalcaris Saylor (1940, p. 309)

Male. Length 10–11 mm.; width 5–6 mm. Body above iridescent, pruinose and rather dull yellow, the pronotum with a large dark somewhat purplish area; front dark brown to nearly black, clypeus reddish. Antennal club 3-segmented, equal in length to 4 preceding segments combined and equal to length of clypeus at middle. Clypeus shallowly emarginate; surface of clypeus and front rather finely and irregularly punctured, the punctures separated by distances ranging from one-half to their own diameters. Pronotum widest at middle, sides behind middle slightly convergent, posterior angles distinct, rather narrowly rounded; shallow punctures separated by an average of about twice their diameters. Anterior tibia tridentate. Lower tooth of tarsal claw strong and median, wider than and fully as long as upper tooth. Elytra with a few erect yellow hairs, some equal to about one-third median length of scutellum; punctures about same size and as equally distributed as those on pronotum. Posterior tibial spurs (fig. 25) very slender; apex of posterior tibia with an abrupt triangular marginal elevation near the small spur; apical margin of tibia with 11–13 spinules. Metasternum shallowly punctured, the punctures well separated on sides, more widely separated on shining median area, and with short hairs not more than one-half width of posterior femur. Pygidium longitudinally wrinkled, shining, glabrous, the punctures separated from once to three times their diameters. Abdomen shining, evenly punctured anterior to penultimate sternite, the punctures separated by about three times their diameters. Genitalia (fig. 24) having each clasper at apex with a strong vertical process, a long extension of the ventral margin and with a round, more lightly sclerotized lobe nearly filling intermediate area between the two extensions; apex of sclerotized tube and expanded part of membrane of aedeagus with a large group of very small spines.

Female. Length 11 mm.; width 5 mm. Similar in all respects to male with antennal club about equal in length and also having a similarly produced tooth on the apical margin of the posterior tibia. Genital plates (fig. 65) separated, each rounded on inside and with a lighter sclerotized area on inner margin; pubic process nearly truncate and with a very narrow sclerotized margin.

RECORDS: Dominican Republic: Rio San Juan, March 1938, (G. S. Miller) [type ♂ number 54017 in U.S.N.M.].

3♂, 1♀ Dominican Republic: Puerto Plata (Hurst) [M.C.Z. and I.N.H.S.].

This species is unique among those known from Hispaniola by having a vertical process on the clasper of the male. It differs also by having a short triangular projection on the apical margin of the posterior tibia. It is nearly similar in color to *aliada* n. sp. but is smaller, and has a different type of tarsal claw.

PHYLLOPHAGA MINUTISSIMA Wolcott

Phyllophaga minutissima Wolcott (1928, p. 28, 76)

Male. Length, 6–7 mm.; width 3 mm. Body shining, pale yellow above, head and central area of pronotum reddish-brown; inner and outer elytral margins and apex of each elytron dark brown. Antennal club 3-segmented, coarsely sculptured, almost as long as stem, and about three-fourths as long as width of clypeus. Clypeus distinctly but shallowly emarginate, with the head rather coarsely and irregularly punctured, the punctures separated from about once to twice their diameters. Pronotum widest at middle, wider at base than at apex, the posterior angles narrowly rounded; surface of pronotum with shallow punctures separated by about twice their diameters. Anterior tibia tridentate. Tarsal segments densely clothed below with long yellow hairs, some of which are over half the length of the segment; tarsal claw with a very short lower basal tooth which is scarcely more than one-fourth the length of upper tooth. Surface of elytra very smooth, the punctures more widely spaced than on pronotum. Posterior tibial spurs nearly straight and slender; apex of tibia at margin with 9–11 spinules. Metasternum shining, rather closely and shallowly punctured except at middle, the punctures closer along posterior margin. Pygidium generally dull, punctures even and separated by about their diameters. Abdomen entirely shining, not closely punctured. Genitalia (fig. 26) with the upper margin of clasper nearly evenly curved from base to apex; apex in caudal view (fig. 27) rather suddenly expanded and truncate; membrane of partially expanded aedeagus with three pairs of curved spines.

Female. Length 8 mm.; width 4 mm. Antennal club subequal to length of clypeus at middle, hardly as long as preceding 4 segments combined. Anterior tarsal hairs not so abundant and conspicuous as those in male. Genital plates (fig. 71) rounded on inside, unmodified; pubic process nearly truncate at apex, with median sclerotized area somewhat bifid at base.

RECORDS: Two paratypes and 10 additional specimens have been examined from Port-au-Prince, Haiti, the type locality, collected in February, March, April and September. Type male and paratypes in United States National Museum. Additional paratypes in collections of American Museum of Natural History and the British Museum.

This, the smallest known species of *Phyllophaga* from Hispaniola, may be distinguished readily from the other species by the pale yellow elytra which are very narrowly dark-margined; the long front tarsal hairs are also distinctive. On the basis of the male genitalia, it is closely related to *esquinada* n. sp. differing by having each clasper truncate and not rounded at apex. The membrane of the aedeagus also has 6 large apical curved spines instead of 4 as in *esquinada*. The inner tibial spur is not angulate in the male as in that species. The female genitalia are somewhat similar to those of *cartaba* n. sp. but have the entire apex of the pubic process nearly truncate and not emarginate as in that species.

PHYLLOPHAGA ESQUINADA n. sp.

Male. Length 9.5 mm.; width 4.5 mm. Color chocolate brown, shining, not pruinose above, sides of pronotum and elytra pale yellow. Antennal club very long, 3-segmented, equal in length to entire stem, and as long as greatest width of clypeus. Clypeus deeply angularly emarginate; surface of clypeus and front shining, very irregularly punctured and uneven; front with a broad, irregular, longitudinal impression on each side of which is an irregular convexity. Pronotum widest at middle, twice as wide as long, the anterior and posterior margins of nearly equal length; posterior angles distinct; punctures shallow, somewhat irregular, separated from one to three times their diameters. Anterior tibia tridentate. Tarsal claw with a short subbasal lower tooth equal to one-third to one-half length of upper tooth. Elytral surface on mesal half very uneven, the irregularly disposed punctures distributed about equally to those on pronotum. Posterior tibial spurs broader than narrowest diameter of first tarsal segment; inner spur (fig. 30) distinctly angulate on outer margin, apical half of spur swollen and rounded at apex; outer spur gradually inflated from base and rounded at apex; margin of tibial apex with 7–8 spinules. Metasternum shining, with large shallow punctures and few scattered hairs. Pygidium with fine longitudinal ridges. Abdomen shining, coarsely but not closely punctured. Genitalia (fig. 29) with each clasper evenly curved from base to apex and unmodified; lobe of aedeagus (fig. 28) with four, short, strongly curved apical spines and two shorter spines, one with two points, on membrane below apex; apex of sclerotized tubular part of aedeagus curved and truncate.

Holotype male, Haiti: La Visite and vicinity, La Selle Range, 5000–7000 feet, September 16–23, 1934 (Darlington).

This species is unique among the Hispaniolan members of this genus by having an angulate inner tibial spur. The simple type of clasper is similar to that of *minutissima* Wolcott, in which character it also resembles *caymanensis* Sanderson (1939, p. 274) from Grand Cayman Island.

PHYLLOPHAGA RECORTA n. sp.

Male. Length 17.5 mm.; width 8 mm. Body above shining, without hairs, elytra yellowish-brown, head and pronotum reddish-brown. Antennal club 3-segmented, very short, about equal to combined length of 4 preceding segments and about three-fourths length of clypeus at middle. Clypeus distinctly but shallowly emarginate, very finely and closely punctured especially toward middle; front with punctures coarser and irregular in distribution. Pronotum widest at middle, the margin in front of middle crenulate; each broadly rounded posterior angle suddenly emarginate; surface of pronotum rather unevenly punctured, the punctures separated from about once to twice their diameters. Anterior tibia tridentate. Tarsal claw with a strong median tooth nearly equal in length to upper tooth. Elytral punctures about same size but a little more evenly spaced than those on pronotum. Posterior tibial spurs very slender, the inner one about the same width as shortest diameter of first posterior tarsal segment; apical margin of posterior tibia with 14–15 spinules. Metasternum finely and evenly punctured, with long yellow hairs scarcely more than three-fourths the greatest width of posterior femur. Pygidium shining, moderately convex, glabrous surface uneven, finely and irregularly punctured. Abdomen very smooth and shining, the large median area with very minute punctures. Genitalia (figs. 31 and 32) with the apex of each clasper about twice as long as wide and beak shaped; aedeagus asymmetrical, the membranous lobe with three large spinous plates toward base and an irregular apical group of spines.

Female. Length 13 mm.; width 8 mm. Antennal club equal in length to that of male. Pygidium strongly convex in apical one-fourth, the apex and sides with long hairs some of which are two-thirds the length of last sternite. A large triangular sclerite between the bases of the plates of the female genitalia (fig. 73), the sclerite nearly joining the base of the pubic process.

Holotype male, Haiti: Kenskoff, near Port-au-Prince, 4000–6000 feet, September 23, 1934 (Darlington).

Allotype female, Haiti: Poste Terre Range, 2000 feet, October 5, 1934 (Darlington).

Although not closely related to any of the known Hispaniolan species, it is somewhat similar to *kenscoffi* Wolcott and related species by having the lateral pronotal margin partly crenulate. It differs from these and all other species by the emarginate posterior pronotal angles. The male clasper is similar to that of *espina* n. sp. but the aedeagi are quite different as shown in the illustrations. This is the only known Hispaniolan species in which there is a complete sclerite between the bases of the genital plates of the female genitalia.

PHYLLOPHAGA KENSCOFFI Wolcott

Phyllophaga kenscoffi Wolcott (1928, p. 24)

Male. Length 26–28 mm.; width 12–14 mm. Color uniformly chocolate brown, shining and without hairs above. Antennal club 3-segmented, as long as 5 preceding segments combined, and one and one-half times length of clypeus at middle. Clypeus distinctly emarginate, closely, finely although somewhat shallowly punctured; front a little more coarsely punctured, the punctures very irregularly placed in median area with wide innerspaces. Pronotum widest just behind middle; posterior angles distinct; lateral margin from near middle to apical angle with 6–7 small but deep angled cuts which present a somewhat crenulate appearance; disc of pronotum with punctures irregular, separated from about once to three times their diameters. Anterior tibia tridentate. Lower tooth of tarsal claw strong, median, as long as upper tooth. Elytral punctures about same size and as evenly spaced as pronotal punctures. Posterior tibial spurs slender, the inner one widest at middle and as wide as narrow diameter of first posterior tarsal segment; apical margin of posterior tibia with 19–22 spinules. Metasternum evenly and finely punctured over entire surface with hairs one-third to one-half width of posterior femur. Pygidium very convex, surface irregular and unevenly punctured; entire posterior margin with a deep groove, the groove becoming increasingly shallower and narrower toward base. Abdomen finely and nearly evenly punctured, the second visible sternite and especially sides of following 3 sternites with long hairs; penultimate sternite depressed posteriorly, depression with a few fine rugae. Genitalia (figs. 33 and 34) with each clasper deeply emarginate on upper margin then strongly, convexly curved to triangular apex; a strong tooth situated on outside of margin of clasper about half way between apex and upper margin; aedeagus (figs. 35 and 36) with a strong and heavily sclerotized tri-pronged process arising at base.

Female. Length 30 mm. Antennal club very little shorter than that of male. Apex of pygidium (fig. 66) conspicuously triangularly produced, the margin with long hairs. Genital plates (fig. 67) together nearly quadrate, joined and produced at their bases to be partially enclosed by a tough sac; inner apex of each plate swollen and with a very short tooth; entire surface with conspicuous longitudinal folds; pubic process (fig. 68) barely visible on ventral side, the sclerotized area almost divided on meson.

RECORDS: Haiti: Port-au-Prince, Kenscoff, 1,400 meters, on apple, July 7, 1927 (Ducasse) [type male, catalogue number 40658, and allotype female in U.S.N.M.] 1 ♂, 1 ♀ paratypes, same data [A.M.N.H.]

1 ♂ Dominican Republic: Mt. Diego de Ocampo, 3000–4000 feet, July 1938 (Darlington) [M.C.Z.]

This is one of the largest *Phyllophaga* known from Hispaniola and is closely related to *neglecta* Blanchard and *mali* Wolcott. From both it differs in its larger size and by having the lateral margins of pronotum crenulate only in front of lateral angles. It also has the paired process of aedeagus deeply divided with apexes pointed, inwardly curved and touching. Both *mali* and *neglecta* have the paired process less deeply divided, somewhat vertical. The female differs from these and all other Hispaniolan species by having the pygidium triangularly produced on apical margin.

PHYLLOPHAGA NEGLECTA Blanchard

Ancylonycha neglecta Blanchard (1850, p. 137)
Ancylonycha neglecta Blanchard. Burmeister (1855, p. 336)
Phyllophaga neglecta (Blanchard). Wolcott (1928, p. 27)

Male. Length 15–18 mm.; width 7–8 mm. Color pale yellowish-brown, pruinose, iridescent, head and pronotum darker than elytra. Antennal club 3-segmented, straight, distinctly longer than combined length of preceding 5 segments, twice as long as clypeus at middle. Clypeus emarginate; clypeus and front with fine shallow punctures, irregularly distributed, separated by once to twice their diameters. Pronotum widest at middle, posterior angles broadly rounded, lateral margin entirely crenulate from base to apex; punctures of disc irregularly placed, separated by distance averaging about three times their diameters. Anterior tibia tridentate. Lower tooth of tarsal claw (fig. 2) strong, median, nearly as long as upper tooth. Elytral punctures a little more closely placed than those on pronotum. Posterior tibial spurs very slender; apical margin of posterior tibia with 17–26 spinules. Metasternum finely and evenly punctured, punctures separated by their diameters, each with a long yellow hair equal to about one-half the width of posterior femur. Surface of pygidium slightly irregular and with fine widely separated punctures. Abdomen finely punctured, punctures closer on sides and on second visible sternite; some punctures with hairs which are arranged in nearly a single transverse row on 3 sternites. Genitalia (figs. 38 and 39) with upper margin of clasper only slightly emarginate; paired, apically united processes of aedeagus (fig. 37) with apical lobes rounded, extended vertically, and with a short median process.

Female. Length 15–19 mm.; width 7–9 mm. Antennal club shorter than in male, equal in length to 4 preceding segments combined and subequal in length to clypeus at middle. Apex of posterior tibia with 28–33 marginal spinules. Each genital plate (fig. 75) nearly truncate at apex, deeply emarginate on outer side; emargination partially filled with membrane; base of each plate rounded on inner angle; pubic process widely sclerotized, the sclerotized area conspicuously produced anteriorly.

RECORDS: An abundant and widely distributed species collected from February to November. Haiti: Port-au-Prince, Petionville, Ennery, Mannville, Diquini, and Grande Rivière. Dominican Republic: Constanza. Recorded by Wolcott at light.

Closely related to *mali* Wolcott it may be distinguished by its average smaller size, the longer club of the antenna in the male and by differences in the male and female genitalia. The apex of each of the paired processes of the male aedeagus in *neglecta* is rounded and directed dorsad (fig. 37). In *mali* this process is pointed and directed ventrad (fig. 41). The female genitalia of the two species are similar, but the sclerotized area of the pubic process of *neglecta* (fig. 75) is wider than in *mali* (fig. 77), and each genital plate of *neglecta* is separately rounded at base and not joined to form a pointed process as usually found in *mali*.

PHYLLOPHAGA MALI Wolcott

Phyllophaga mali Wolcott (1928, p. 25)

Male. Length 17.5–20 mm.; width 9–11 mm. Very similar in appearance to *neglecta* Blanchard but averaging slightly larger and more reddish in color. The 3-segmented antennal club about equal to combined length of 5 preceding segments and a little longer than clypeus at middle. Clasper of male genitalia (figs. 40 and 42) more depressed on upper margin than *neglecta*, and aedeagus (fig. 41) differently shaped as illustrated; median lobe three-fourths as long as each lateral process, but in *neglecta* this lobe only about half as long.

Female. Length 19–22 mm.; width 10–11 mm. Antennal club equal to 4 preceding segments combined, shorter than clypeus at middle. Genital plates (fig. 77) closely associated at base and together forming a somewhat pointed process that extends into a very tough sac in the membrane; apex of each plate truncate, inner margins declivous and subcarinate; pubic process shallowly emarginate at apex and with the sclerotized area at middle only slightly extended toward base.

RECORDS: March, April, June, July, October. Haiti: Kenscoff [type male, catalogue number 40659, and allotype female in U.S.N.M.] Port-au-Prince, Furcy, Diquini, Cape Haitien, Tortue Island. Dominican Republic: Marcoris, Rio San Juan, Puerto Plata, San Domingo. Recorded by Wolcott from apple and rose.

This is one of the most variable of all known Hispaniolan *Phyllophaga* if all the individuals studied actually constitute one species. The median lobe of the aedeagus of the male is sinuately curved in some individuals (fig. 43) and evenly curved in others (fig. 41). The joined lateral processes are narrower near the apex in the larger Port-au-Prince males (fig. 41) but are broader in some of the smaller males from other localities (fig. 43). The male genitalia resemble those of *kenscoffi* Wolcott but have the aedeagus differently shaped as shown in the illustrations.

The female genitalia are a little less variable than those of the male. A female from Cape Haitien has the genital plates joined at their apexes, but all other females studied had the two lobes separated as in fig. 77. Although resembling closely the female of *barrosa* n. sp., it may be distinguished readily by the truncate genital plates. Other differences are shown in the illustrations.

PHYLLOPHAGA AUDANTI Wolcott

Phyllophaga audanti Wolcott (1928, p. 27)

Male. Length 8–10 mm.; width 4.5–5 mm. Body entirely smooth and shining above without pruinosity or iridescence. Color light brownish-yellow. Antennal club 3-segmented, slightly shorter than 5 preceding segments combined, equal in length to clypeus at middle. Clypeus very shallowly emarginate, the punctures nearly evenly distributed and separated by about their diameters; front with a faint median impression and with punctures a little less regularly placed than on clypeus. Pronotum widest at middle, sides slightly convergent to rounded basal angles; punctures irregular, separated from once to twice their diameters. Anterior tibia tridentate. Lower tooth of claw short, near base, and about one-third length of upper tooth. Elytral punctures similar to those on pronotum. Tibial spurs slender, the inner one equal to narrow diameter of first posterior tarsal segment; apical margin of posterior tibia with about 12–17 spinules. Metasternum with punctures separated by about three times their diameters each puncture with a seta equal to about one-half width of posterior femur; central area of metasternum smooth and shining. Pygidium evenly colored, nearly evenly punctured, the punctures separated by once to twice their diameters. Abdomen almost entirely smooth and shining, the punctures becoming much coarser and closer from central area to sides. Genitalia (figs. 44 and 45) with the upper margin of clasper concave before apex; aedeagus with 4 very slender rod-like spines, disposed in pairs, the two spines of each pair directed mesad, sometimes crossing when aedeagus is retracted.

Female. Length 9–10 mm.; width 4–5 mm. Antennal club equal in length to that of male. Genital plates rounded on inside as in fig. 71; pubic process (fig. 72) deeply emarginate at apex, the emargination nearly filled with membrane; sclerotized area distinctly longer than wide and bifid at base.

RECORDS: Haiti: Port-au-Prince [type male, catalogue number 40661, and allotype female in U.S.N.M.].

Haiti: Port-au-Prince, many individuals collected from January to May, and in August and September at light.

Haiti: San Michel.

2♂ Dominican Republic: Santiago, March 25, 1936. (Rosario).

13♂ ♀ Dominican Republic: Ciudad Trujillo, November 26, 1943 (Friauf).

This species is a little larger than *latiungula* Wolcott, and differs from it and allies by its entirely glabrous and shining dorsal surface. The clasper is similar to that of *imprima* n. sp. but the aedeagus has 4 long processes instead of 2 as in that species. The female genitalia are somewhat similar to those of *cartaba* n. sp. but the pubic process is more deeply emarginate at apex, and the emargination is nearly filled with a membrane.

PHYLLOPHAGA CARTABA n. sp.

Male. Length 8–10 mm.; width 4–4.5 mm. Color light reddish-brown, elytra slightly pruinose, iridescent, a little lighter than head and pronotum. Antennal club 3-segmented, nearly one-fourth longer than 5 preceding segments combined, a little more than twice length of clypeus at middle. Clypeus distinctly emarginate; surface of clypeus and head with very irregular and rather coarse punctures; front with distinct longitudinal impression, the surface on either side toward clypeo-frontal suture less closely punctured than adjacent areas. Pronotum generally widest at middle, the basal angles very distinct; disc with irregularly placed shallow punctures which are separated by an average of about three times their diameters. Anterior tibia tridentate. Lower tooth of claw nearly median, very short, broadly triangular, equal in length to about one-half of the much narrower upper tooth. Elytral punctures about same size as those on pronotum but more regularly spaced. Tibial spurs moderately broad, the inner about two-thirds as wide as the greatest width of first posterior tarsal segment; apical margin of posterior tibia with 13–15 spinules. Metasternum with punctures widely separated; median area smooth and shining. Median third of pygidium very smooth, shining and with widely spaced shallow punctures; sides of pygidium dull. Abdomen smooth and shining at middle, fine punctures widely spaced. Genitalia (figs. 46 and 47) with the upper margin of clasper curved and then nearly truncate at apex, and terminating in a broad tooth; aedeagus (fig. 46) with 3 or 4 spines on membrane at apex.

Female. Length 8 mm., width 4 mm. Antennal club similar in size to that of male, and the sexes very similar. Genital plate rounded inside and unmodified. Pubic process (fig. 70) well developed, the length and width of sclerotized area subequal; apex emarginate, base deeply emarginate.

Holotype male, Dominican Republic: "S.Dom."

Allotype female, same data.

7♂ paratypes, same data [3♂ in I.N.H.S.].

This species is more closely related to *latiungula* Wolcott than to other Hispaniolan species. The clypeus is distinctly emarginate and the central area of the pygidium is even and with punctures finer and more widely separated than in *latiungula.* The male genitalia are somewhat similar but the aedeagus of *cartaba* n. sp. has 3 or 4 spines in the apical membrane whereas *latiungula* has about 14. The female genitalia of the two species are also similar, but the pubic process in *cartaba* is less deeply divided than that in *latiungula.*

PHYLLOPHAGA PANICULA n. sp.

Male. Length 11.5 mm.; width 5 mm. Color reddish-brown, iridescent, shining. Antennal club 3-segmented, longer than 5 preceding segments combined and more than twice as long as clypeus at middle. Clypeus gradually rounded to the very slightly emarginate apex; surface strongly concave, slightly convex at middle, with shallow irregularly placed punctures, the median area nearly smooth; vertex with punctures generally a little deeper and closer than those on clypeus, slightly irregularly convex on each side of shallow median longitudinal impression. Pronotum with shallow, rather widely separated irregular punctures; lateral margins straight and parallel in basal half; basal angles distinct. Elytral surface somewhat irregular with punctures of same size as those on pronotum, separated by about three times their diameters. Anterior tibia tridentate. Lower tooth of claw median and about one-half length of upper tooth. Posterior tibia without spines; inner apical spur not quite so long as first tarsal segment, broader at middle, pointed at apex; outer spur nearly parallel, about three times longer than broad; apex of tibia with 14 spinules. Metasternum rather coarsely punctured, punctures widely separated in large median shining area and more closely placed on pruinose sides; hairs not so long as width of posterior femur. Pygidium with surface very uneven and with a few large punctures toward basal margin. Male genitalia (figs. 48 and 51) similar to those of *latiungula* Wolcott.

Holotype male, Haiti: Ouest Haiti, Kenscoff, May 3, 1937, 4300 feet (Chester Roys). Type in collection of the University of Michigan.

This species closely resembles *imprima* n. sp., *cartaba* n. sp., and *latiungula*, and to the latter it is most closely related. However, it is a little larger than *latiungula*, the antennal club is longer, and there are differences in the claspers. The small tooth on the side near the apex of the clasper of *panicula* does not reach the apical margin when clasper is examined in lateral view, but the tooth extends beyond the margin on the clasper of *latiungula*.

PHYLLOPHAGA IMPRIMA n. sp.

Male. Length 10.5–12 mm.; width 6 mm. Color reddish-brown, strongly pruinose and iridescent above; head and pronotum darker than elytra. Antennal club 3-segmented, equal to combined length of 4 preceding segments. Anterior margin of clypeus slightly emarginate; surface of clypeus and front coarsely and irregularly punctured; front with a strong median longitudinal impression on each side of which the front is raised and convex. Pronotum widest at base, the posterior angles distinct; anterior margin slightly concave; surface glabrous, with shallow irregular punctures separated from once to about four times their diameters; a smooth median, and a nearly smooth area near lateral angle. Anterior tibia tridentate. Tarsal claw with a strong median lower tooth equal to about two-thirds length of upper tooth. Elytra glabrous, with small shallow punctures averaging a little closer and more even than pronotal punctures. Posterior tibial spurs very slender, at most about as wide as narrowest part of first tarsal segment; apex of tibia with 13–14 spinules on margin. Metasternum with very shallow widely separated punctures, almost entirely without hairs; surface pruinose and dull except for a large triangular shining median area. Pygidium with median one-third shining and with coarser punctures than pruinose sides. Abdomen pruinose except for large shining median area; punctures shallow, separated by two to three times their diameters. Genitalia (figs. 52 and 53) having the upper part of apex of clasper with a very short triangular point; aedeagus (fig. 52) with two slender processes, each gradually tapering from the rounded base.

Holotype male, Dominican Republic: Mt. Quita-Espuela, 2000-3000 feet. July 1938 (Darlington).

♂ paratype, Dominican Republic: "S. Dom." [I.N.H.S.].

This species is similar in appearance and is closely related to *mella* n. sp. It is a little shorter than *mella*, the head is deeply longitudinally impressed or bituberculate, and there are notable differences in the male genitalia as shown in the illustrations.

PHYLLOPHAGA LATIUNGULA Wolcott

Phyllophaga latiungula Wolcott (1928, p. 28)

Male. Length 8.5 mm.; width 4–4.5 mm. Dorsal surface of body dull yellow with bluish iridescence; head and pronotum somewhat reddish-brown, darker than elytra. Antennal club 3-segmented, equal to combined length of 5 preceding segments, about one-third longer than clypeus at middle; clypeus very faintly emarginate together with front bearing nearly regularly spaced shallow punctures; a faint median longitudinal impression on front. Pronotum nearly parallel in basal half; disc very irregularly punctured with large, nearly smooth areas; punctures of two sizes and separated by an average of three or four times their diameters. Anterior tibia tridentate. Tooth of claw strong and median, about three-fourths length of upper tooth. Elytral surface irregular, punctures more evenly spaced than those on pronotum. Tibial spurs broad, the inner two-thirds as wide as greater diameter of first posterior tarsal segment; apical margin of posterior tibia with 12–15 spinules. Metasternum with scattered punctures, a large shining median area, almost devoid of hairs. Pygidium dull on sides, shining and dark brown in median third, the punctures very shallow, irregular and not well marked. Abdomen with a large smooth and shining area, the punctures fine, not closely placed. Genitalia (figs. 49 and 50) with the claspers evenly curved on dorsal margin, the triangular tooth at apex very small; retracted membrane of aedeagus with 12–13 spines, each about three or four times longer than wide.

Female. Length 9.5–10.5 mm.; width 5 mm. Antennal club same size as that of male. Genital plate rounded on inside as in fig. 71; pubic process (fig. 69) strongly sclerotized, the two halves almost divided at middle; apex sinuately emarginate.

RECORDS: Haiti: Carrefour near Port-au-Prince, at light, April 2, 1925 [type female, catalogue number 40662, in U.S.N.M.]. 5♂, 2♀ Haiti: Port-au-Prince (R. J. Crew) [M.C.Z. and I.N.H.S.].

Superficially this species resembles *cartaba* n. sp. in size and color but differs chiefly from that species by having 12 to 13 aedeagal spines. It is much smaller than *mella* n. sp., to which it shows some relationships, but does not have the dense groups of short spines on the lower side of apex of tubular part of aedeagus as in that species. The genitalia of the female are similar to those of *cartaba* but have the sclerotized area of the pubic process more deeply divided.

PHYLLOPHAGA MELLA n. sp.

Male. Length 13.5–15 mm.; width 6.5–7 mm. Color reddish-brown, strongly pruinose and iridescent above; head and pronotum a little darker than elytra. Antennal club 3-segmented, equal in length to combined length of 5 preceding segments, and nearly one-third longer than clypeus at middle. Clypeus distinctly emarginate, surface shining, irregularly punctured; front dull, with punctures more widely separated than on clypeus. Pronotum very slightly wider at base, posterior angles distinct; punctures rather fine and shallow, irregularly placed and separated from two to several times their diameters. Anterior tibia tridentate. Tarsal claw with a strong median lower tooth nearly equal to upper tooth. Elytra glabrous, the punctures closer than those on pronotum. Posterior tibial spurs very slender, equal in width to narrowest diameter of first tarsal segment; apex of tibia with 10 spinules on margin. Metasternum finely and shallowly punctured, a large central smooth area, hairs very short. Pygidium dull except for median shining area which is more coarsely punctured than adjacent areas. Abdomen with a large central shining area which is finely but not closely punctured. Genitalia (figs. 55 and 56) with the upper part of clasper distinctly triangularly produced; lower margins of sclerotized part of aedeagus (fig. 54) with a longitudinal group of about 15 short heavy spinules; expanded membranous lobe of aedeagus with a dorsal row, an apical group and a large ventral group of spines which are variable in length.

Female. Length 14–16 mm.; width 6–8 mm. Resembling the male of *espina* n. sp. in general appearance. Genitalia (fig. 74) with a well developed sclerite toward base of genital plates, the sclerite modified to form a pair of curved pointed processes, intermediate area membranous; pubic process elongate, completely divided. Posterior tibia with 15 apical spinules.

Holotype male, Dominican Republic: foothills Cordillera Central south of Santiago, June 1938 (Darlington).

Allotype female, Dominican Republic: Mt. Diego de Ocampo, 3000–4000 feet, July 1938 (Darlington).

1 ♂, 1 ♀ paratypes, same data as holotype [one in I.N.H.S.].

1 ♂, 1 ♀ paratypes, Dominican Republic: San Jose de las Matas, 1000–2000 feet, June 1938 (Darlington) [one in I.N.H.S.].

1 ♂ paratype, Dominican Republic: Constanza, 3000–4000 feet, August 1938 (Darlington).

Closely related to *imprima* n. sp., the male differs chiefly by having many spines on the sac of the aedeagus and not two as in that species. The head in *mella* is nearly smooth and not bituberculate as in *im-*

prima. The divided pubic process of the female is also characteristic of *canoa* n. sp., but the latter species does not have a sclerite at the base of the genital plate. In *recorta* n. sp., the only other species having this sclerite, the structure is triangular and completely covers the area between the genital plates.

PHYLLOPHAGA CANOA n. sp.

Female. Length 19 mm.; width 9 mm. Color deep chocolate-brown, shining, glabrous. Antennal club 3-segmented, equal in length to preceding 4 segments combined, subequal in length to clypeus at middle. Clypeus distinctly emarginate with a few shallow irregularly placed punctures similar to those on front; front with a shallow longitudinal impression, and each side next to the eye with a deep longitudinal groove reaching from the posterior impunctate area near pronotum to the strongly impressed fronto-clypeal suture. Pronotum widest at middle of the evenly curved lateral margins, the anterior angles sharp and prominent, the posterior angles very broadly rounded, almost imperceptible; pronotal punctures fine, shallow, irregularly placed, separated from once to about three times their diameters. Anterior tibia tridentate. Lower tooth of claw strong, median, nearly as long as upper tooth. Surface of elytra irregular, punctures somewhat obliterated, a little more closely placed than those on pronotum. Apical margin of posterior tibia with 19–20 spinules; first posterior tarsal segment short, suddenly enlarged about middle, with apical margin produced on inside into a tooth. Metasternum, especially on sides, very finely and closely punctured, with long hairs equal to about one-half width of posterior femur. Pygidium irregularly punctured, the punctures closer and coarser in anterior half. Genitalia (fig. 60) with the pubic process completely divided, each part consisting of a slender rod and with long hairs in apical region.

Holotype female, Dominican Republic: vicinity of Valle Nuevo, cloudforest, 6000 feet, August 1938 (Darlington).

This species is about the size and general appearance of *hogardi* Blanchard but differs from all known Hispaniolan species by the deep longitudinal groove paralleling the eye.

PHYLLOPHAGA ALIADA n. sp.

Female. Length 14 mm.; width 6 mm. Color of elytra yellowish, iridescent; pronotum and head reddish-brown, the head darker. Antennal club 3-segmented and subequal in length to preceding 3 segments combined. Clypeus (fig. 58) rounded on sides, apex slightly emarginate and reflexed; surface shining, without hairs and with shallow punctures spaced at about their own diameters; head without hairs, the punctures a little more irregularly spaced than on clypeus. Pronotum glabrous, finely and shallowly punctured, punctures spaced one to three or four times their diameters; sides of pronotum smooth, slightly convergent from about the middle to basal angles, wider at base than at apex. Anterior tibia tridentate. Tarsal claw (fig. 57) with upper and lower teeth subequal in length. Posterior tibia with spurs slender and nearly straight; outer margin of tibia at apex with 17-19 spinules. Metasternum finely, not densely punctured, the hairs about half the width of posterior femur. Elytra gradually inflated behind, about as finely punctured as pronotum. Pygidium glabrous, except for apical fringe of long hairs; punctures fine, closely, irregularly placed. Genitalia (fig. 59) with the pubic process straight on posterior margin, and at each end a group of long hairs.

Holotype female, N. Haiti: Mt. Basil, 4700 feet, September 9, 1934 (Darlington).

The distinctly cleft tarsal claw will distinguish this species and *fossoria* n. sp. from all others known from Hispaniola. In *aliada*, the upper and lower teeth of the tarsal claws are nearly equal in length, and the clypeus is rounded on the sides. In *fossoria*, known only from males, the upper tooth of the claw is longer than the lower and the sides of the clypeus are nearly straight.

PHYLLOPHAGA BARROSA n. sp.

Female. Length 19 mm.; width 10 mm. Color above iridescent reddish-brown. Clypeo-frontal suture deeply triangularly impressed on each side toward eye. Apex of each genital plate (fig. 76) prolonged beyond emargination of pubic process; plates together emarginate at base with a partially sclerotized rounded structure behind emargination; margins of sclerotized apex of pubic process in central area parallel.

Holotype female, Haiti: Fond des Negres, March 31, 1927 (A. Wetmore). Type in collection of the United States National Museum.

This species is closely related to the female of *mali* Wolcott and differs chiefly by having the apexes of the genital plates produced beyond the margin of the pubic process. In *mali* each plate is nearly truncate at apex, and together they are pointed at base, not emarginate as in *barrosa*.

UNRECOGNIZED SPECIES

Lachnosterna major Moser (1918, p. 59)

This species, described from Santo Domingo, has not been reidentified but the description indicates a close relationship to the *hogardi* complex.

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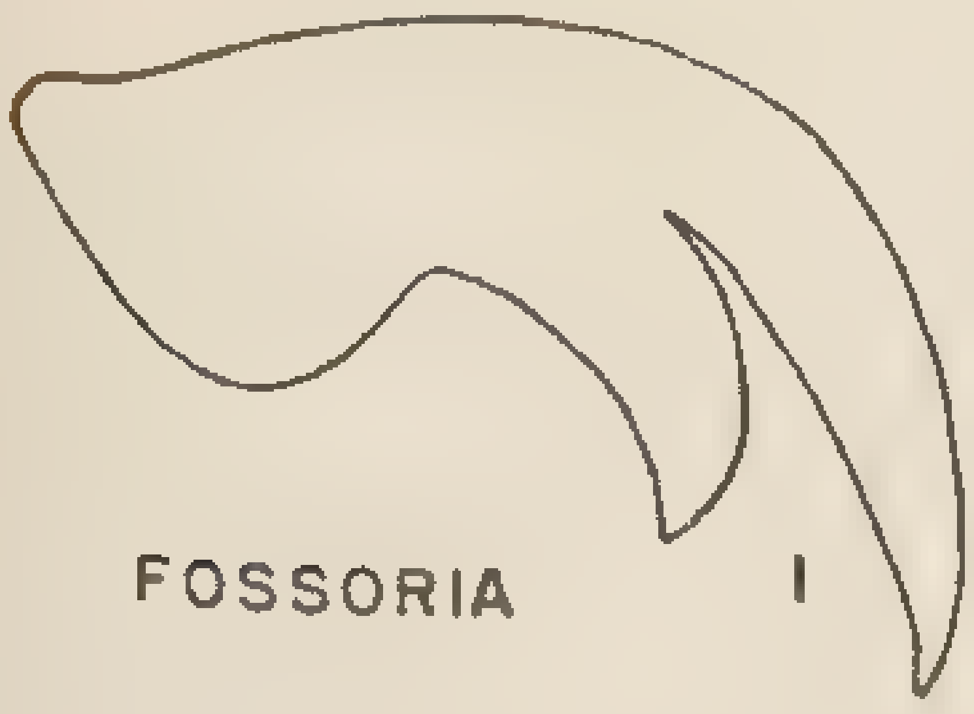
PLATES

PLATE 1

Phyllophaga spp.

Fig. 1. *fossoria* n. sp., tarsal claw of male.
Fig. 2. *neglecta* (Blanchard), tarsal claw of male.
Fig. 3. *permagna* (Moser), elytral spine of male.
Fig. 4. *hogardi* (Blanchard), first and second posterior tarsal segments of male.
Fig. 5. *fossoria* n. sp., male clasper and aedeagus, lateral.
Fig. 6. *fossoria* n. sp., male clasper, ventral.
Fig. 7. *permagna* (Moser), male clasper, caudal.
Fig. 8. *permagna* (Moser), male clasper and aedeagus, lateral.
Fig. 9. *permagna* (Moser), male aedeagus, ventral.
Fig. 10. *hogardi* (Blanchard), male clasper, lateral.
Fig. 11. *hogardi* (Blanchard), male clasper, caudal.
Fig. 12. *romana* (Saylor), male clasper, lateral.
Fig. 13. *romana* (Saylor), male clasper, ventral.
Fig. 14. *leptospica* n. sp., male clasper, lateral.
Fig. 15. *leptospica* n. sp., male clasper, ventral.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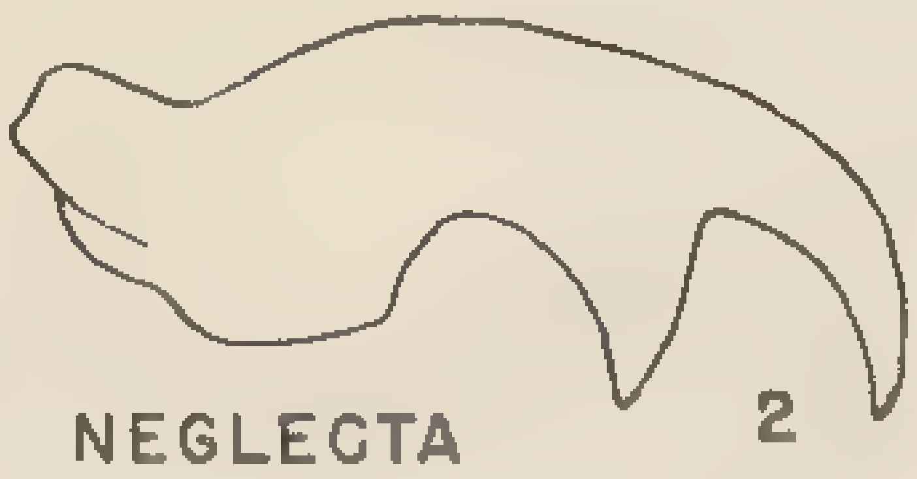
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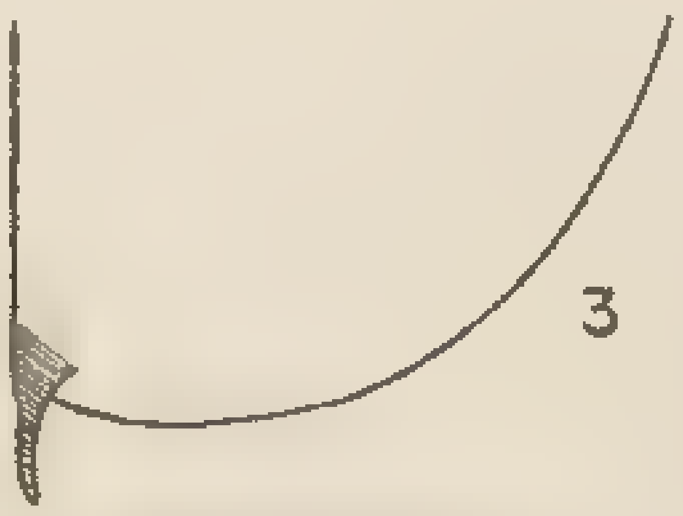
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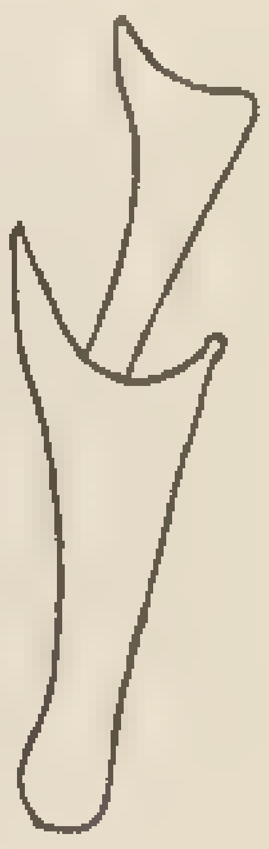
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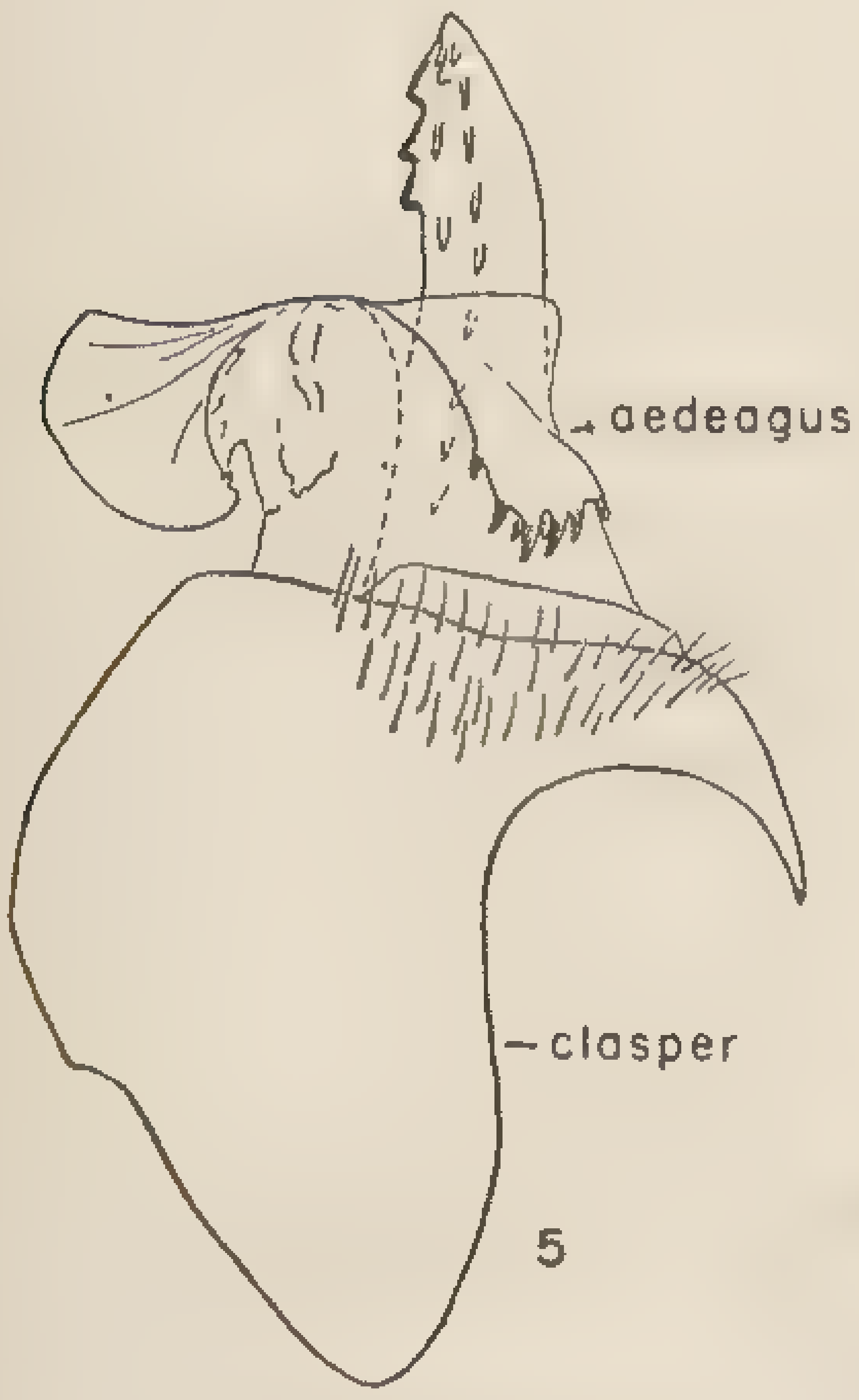
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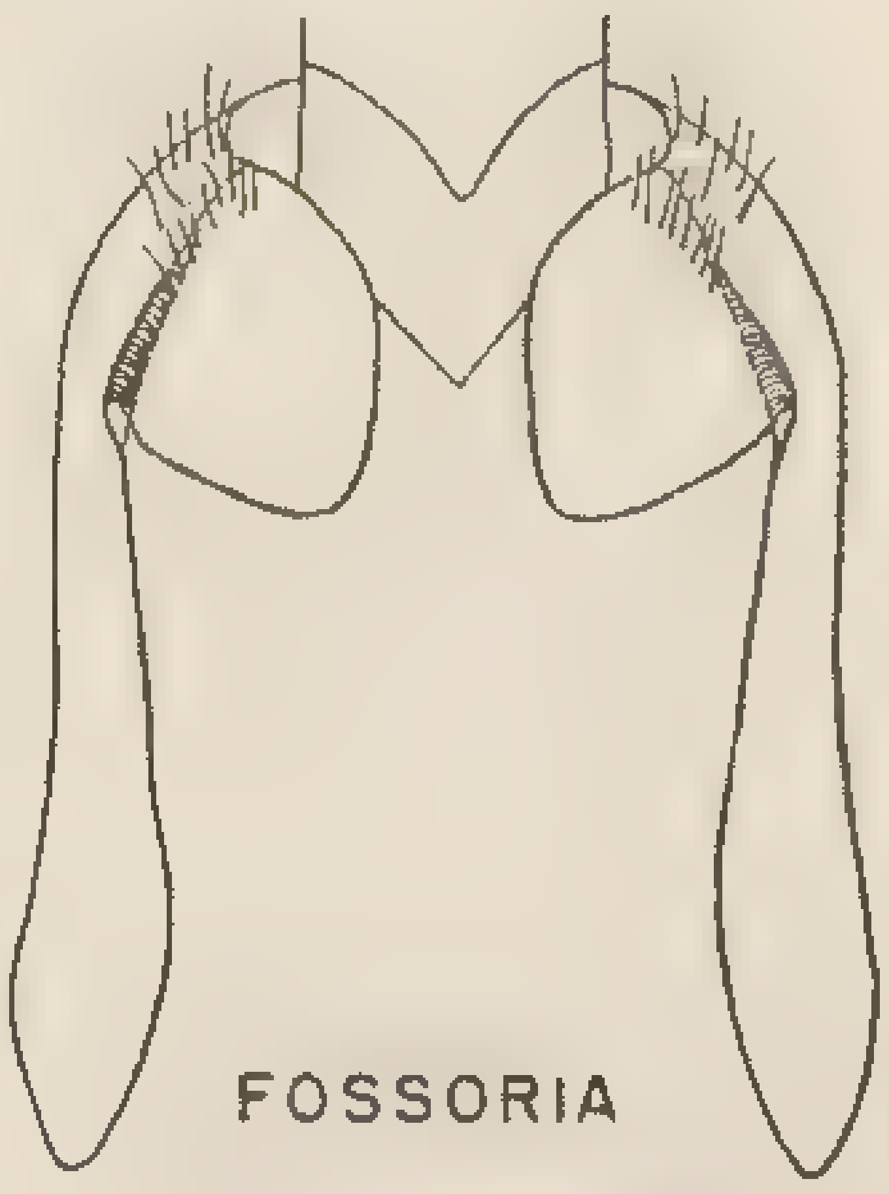
5 FOSSORIA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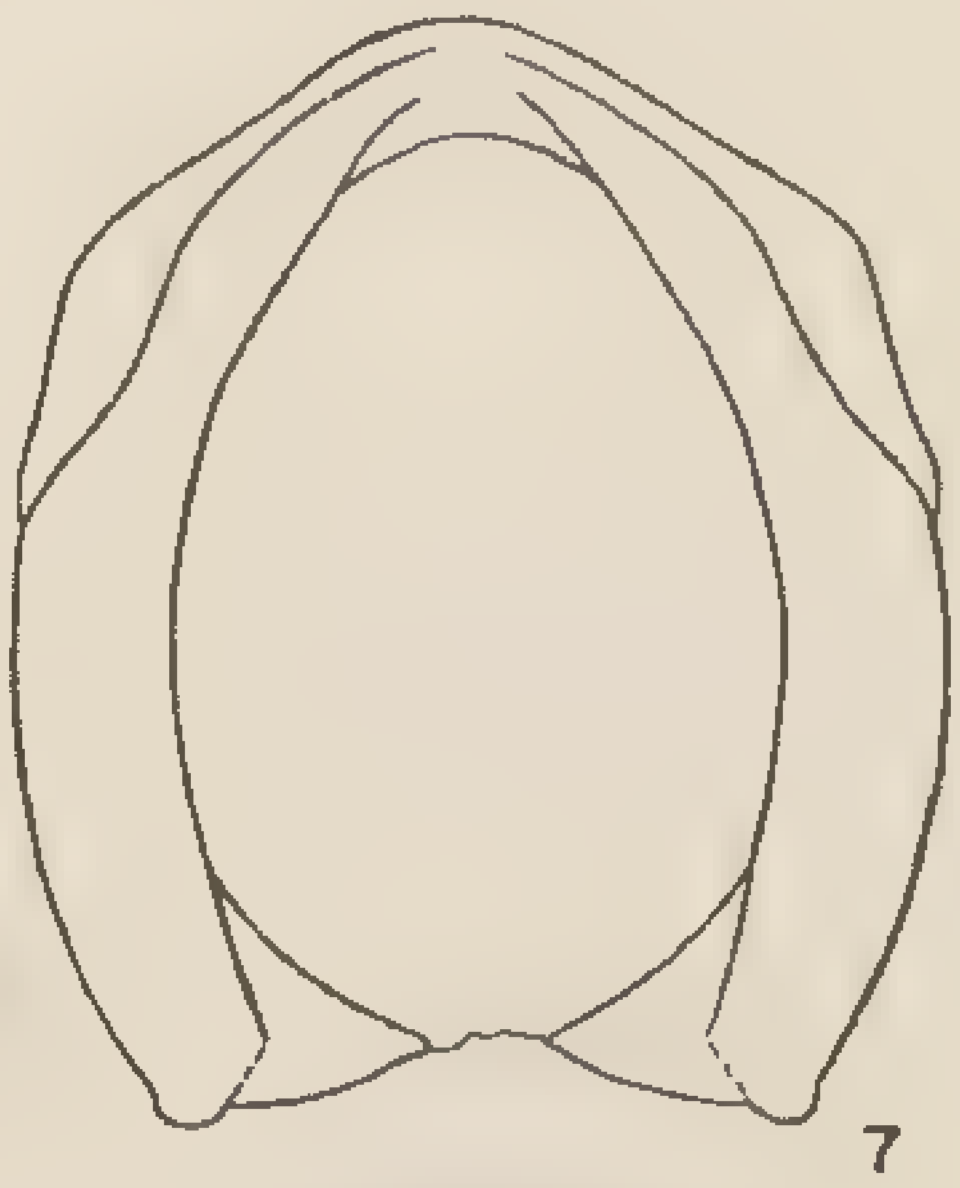
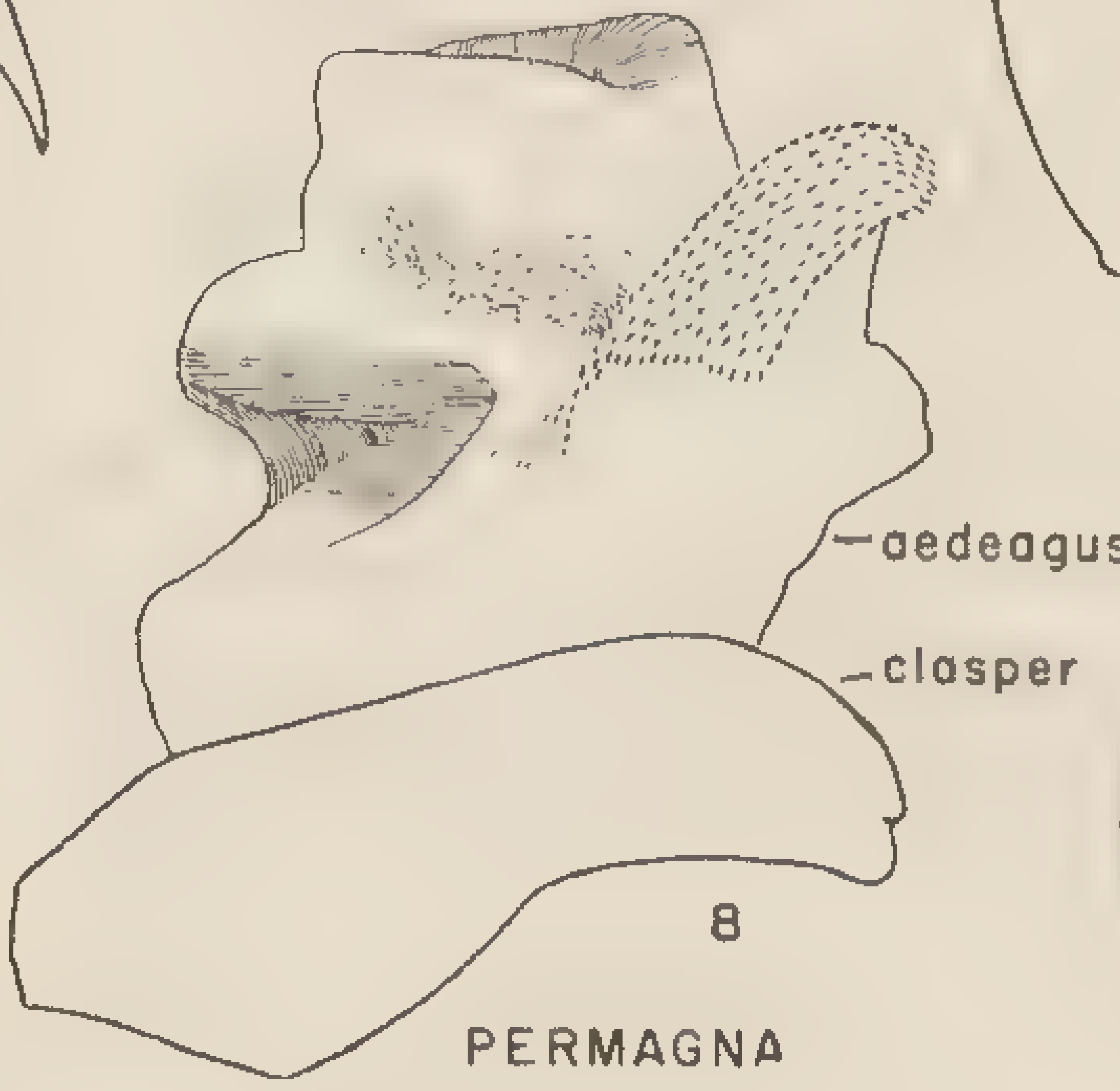
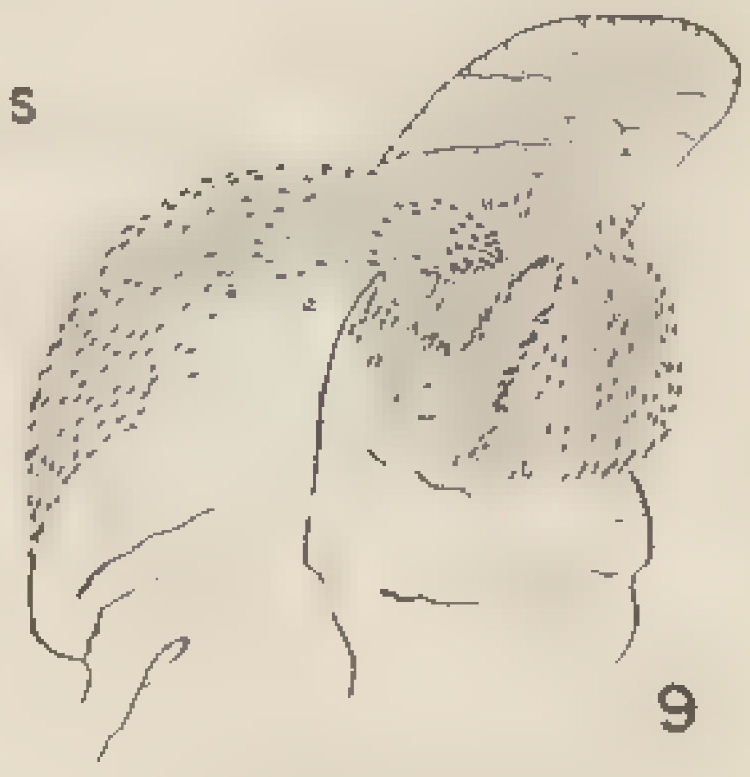
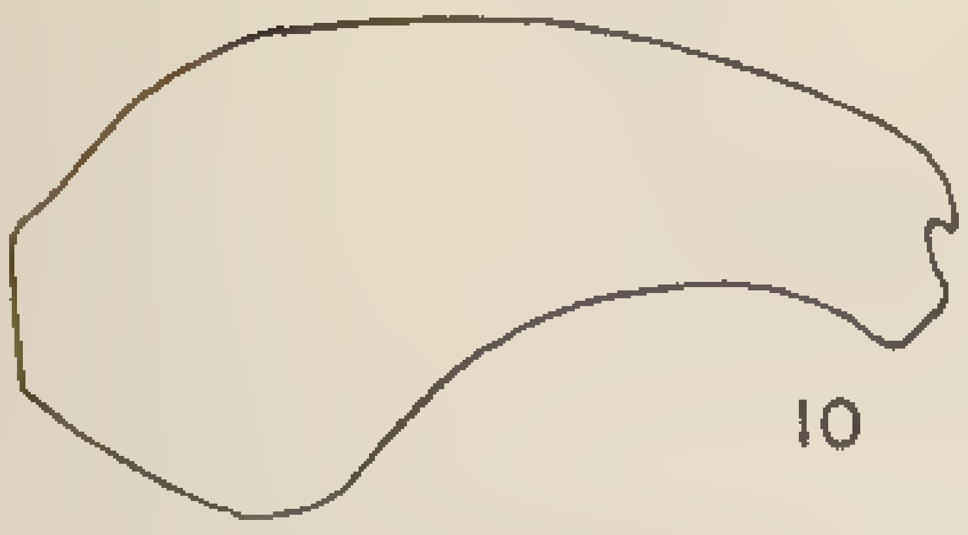
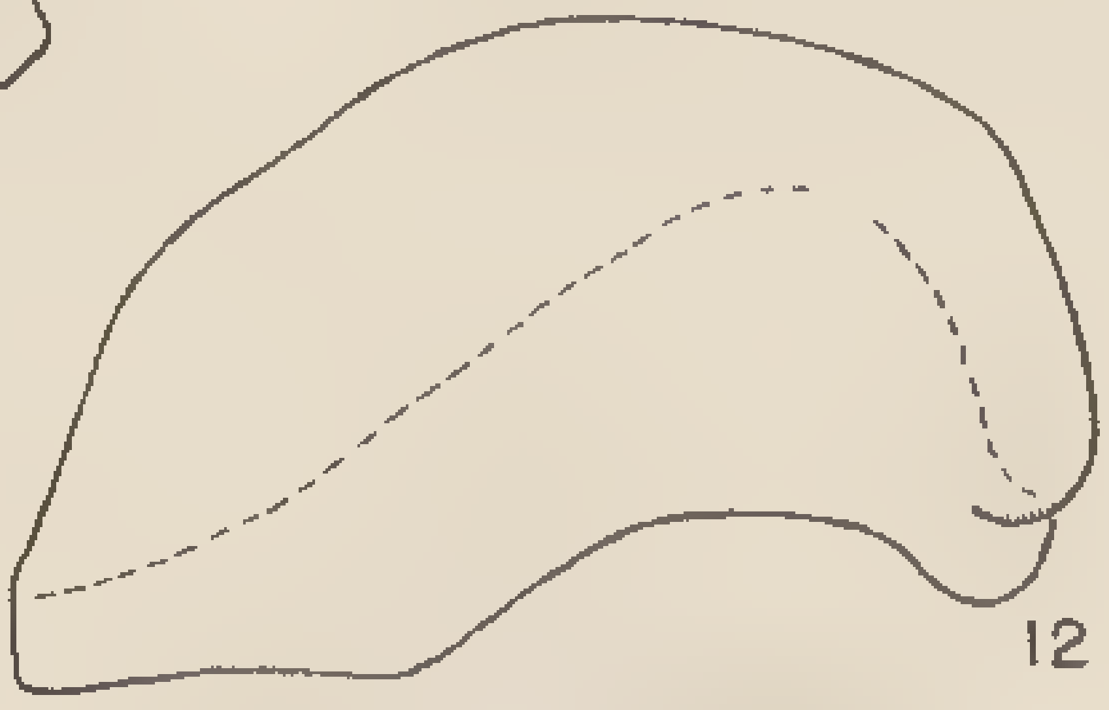
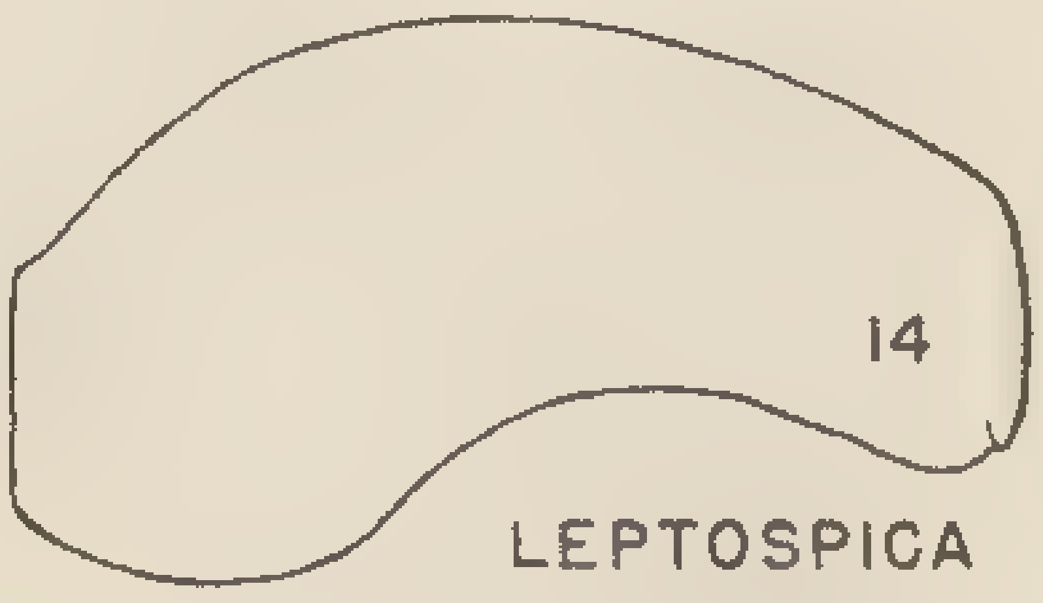

7 PERMAGNA

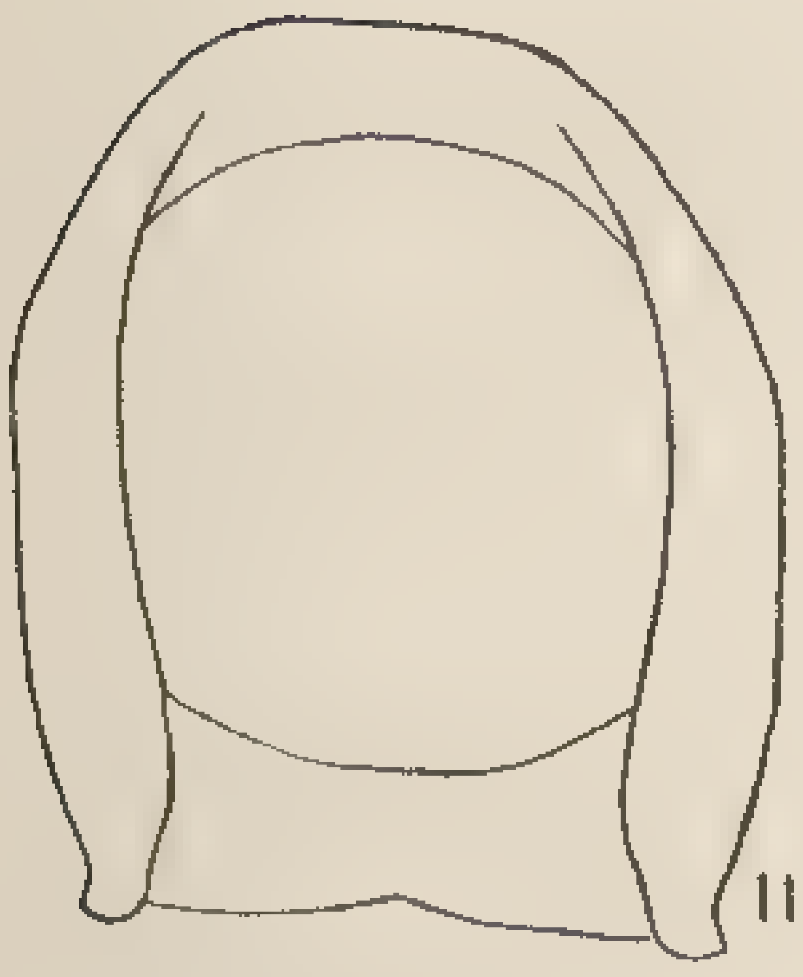

aedeagus
clasper
8 PERMAGNA

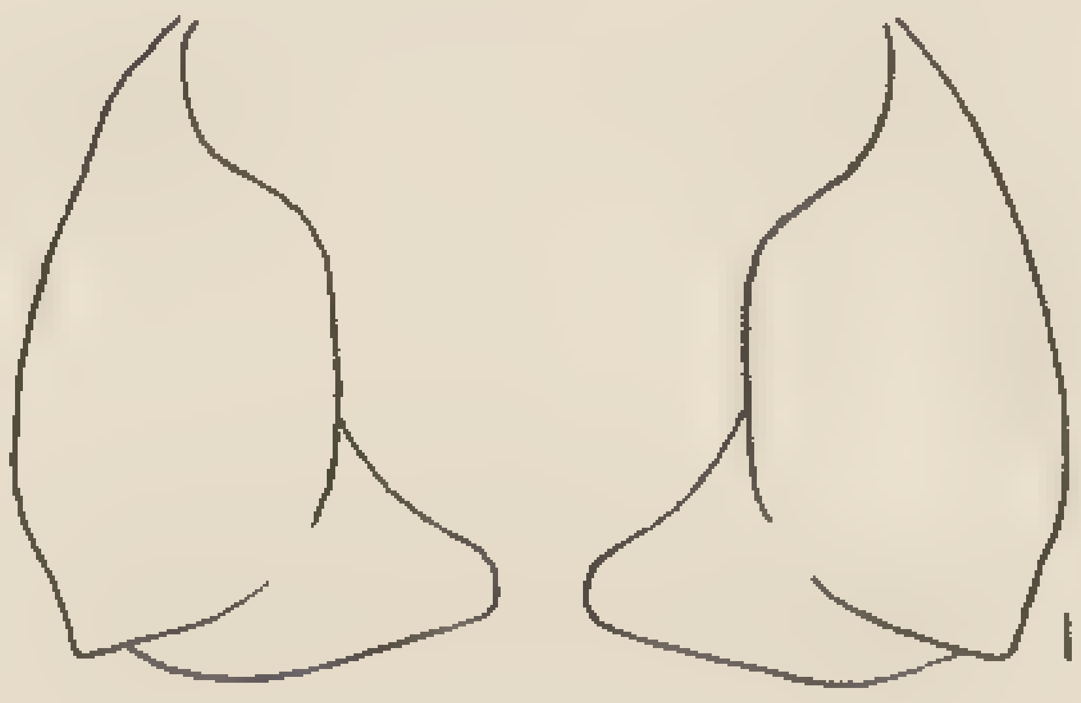

9 PERMAGNA


10 HOGARDI


12 ROMANA


14 LEPTOSPICA


11 HOGARDI


13 ROMANA

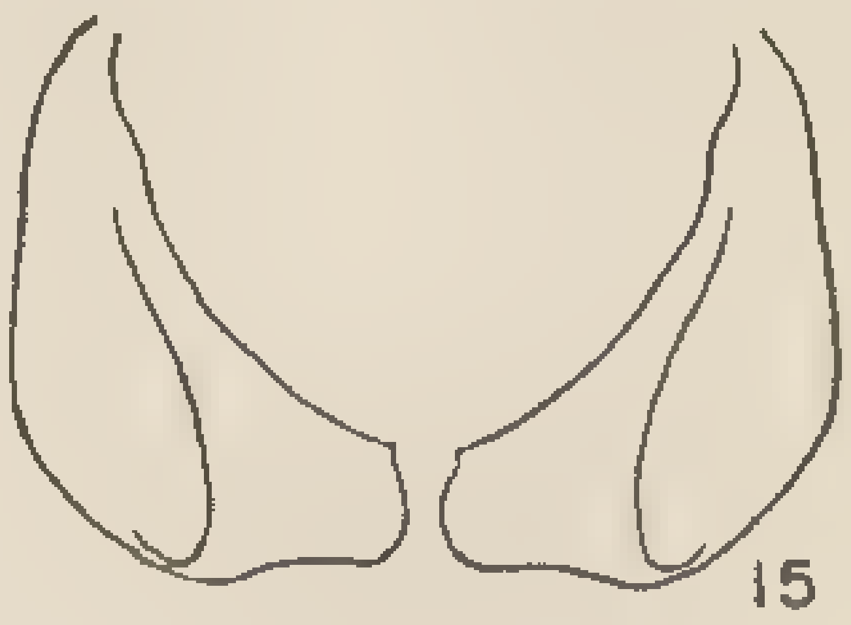
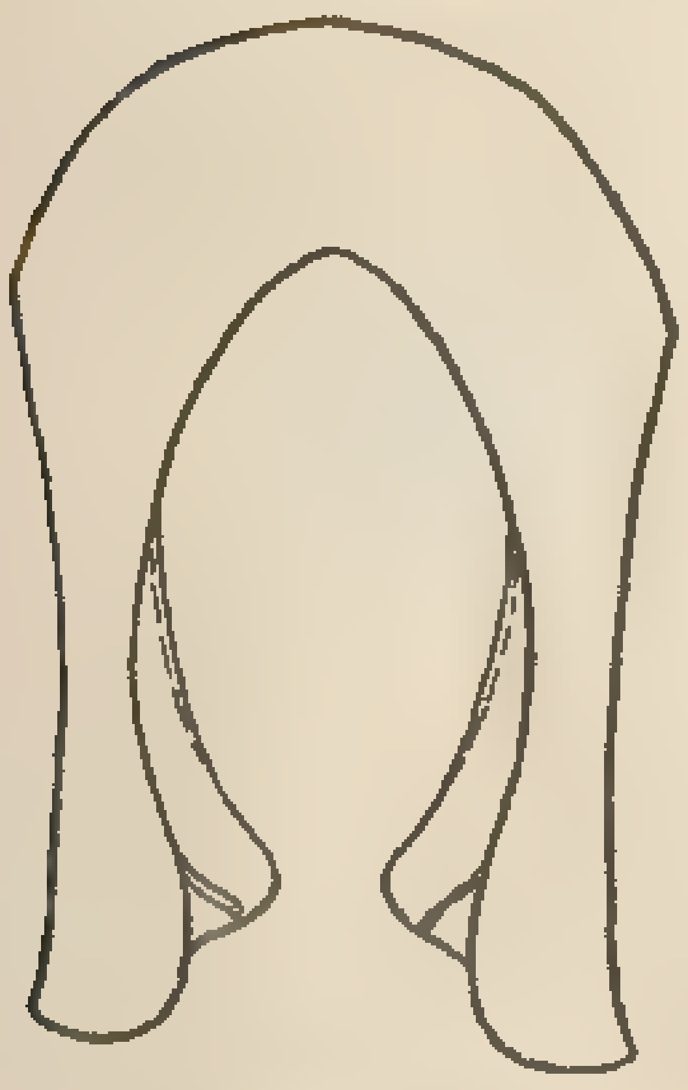

15 LEPTOSPICA

PLATE 2

Phyllophaga spp.

Fig. 16. *garrota* n. sp., male clasper, caudal.
Fig. 17. *garrota* n. sp., male clasper and aedeagus, lateral.
Fig. 18. *probapora* n. sp., male clasper, caudal.
Fig. 19. *probapora* n. sp., male clasper and aedeagus, lateral.
Fig. 20. *costura* n. sp., male clasper, caudal.
Fig. 21. *costura* n. sp., male clasper and aedeagus, lateral.
Fig. 22. *espina* n. sp., male clasper, caudal.
Fig. 23. *espina* n. sp., male clasper and aedeagus, lateral.
Fig. 24. *pseudocalcaris* Saylor, male clasper and aedeagus, lateral.
Fig. 25. *pseudocalcaris* Saylor, male posterior tibia showing pseudospur. (t_1 = first tarsal segment).
Fig. 26. *minutissima* Wolcott, male clasper and aedeagus, lateral.
Fig. 27. *minutissima* Wolcott, male clasper, caudal.



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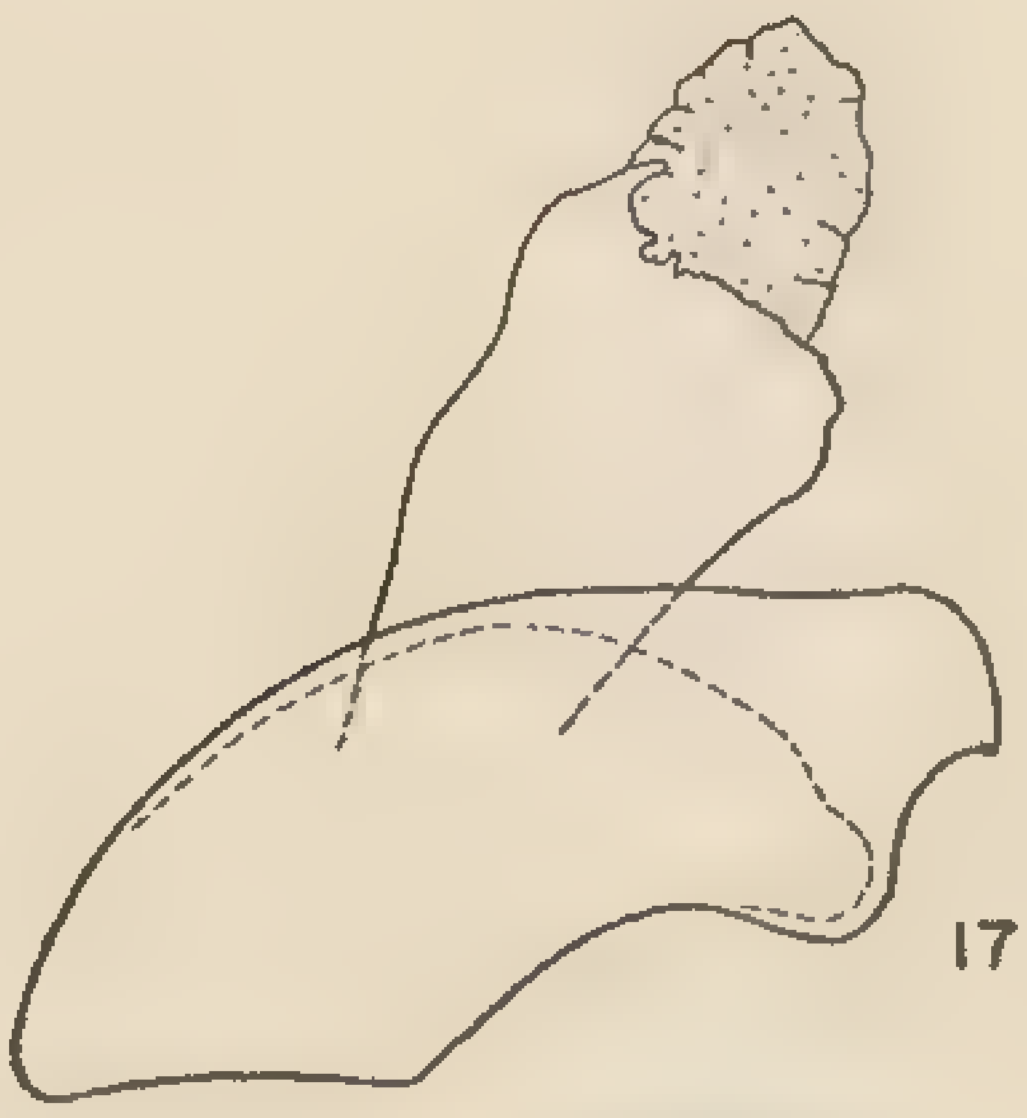
GARROTA



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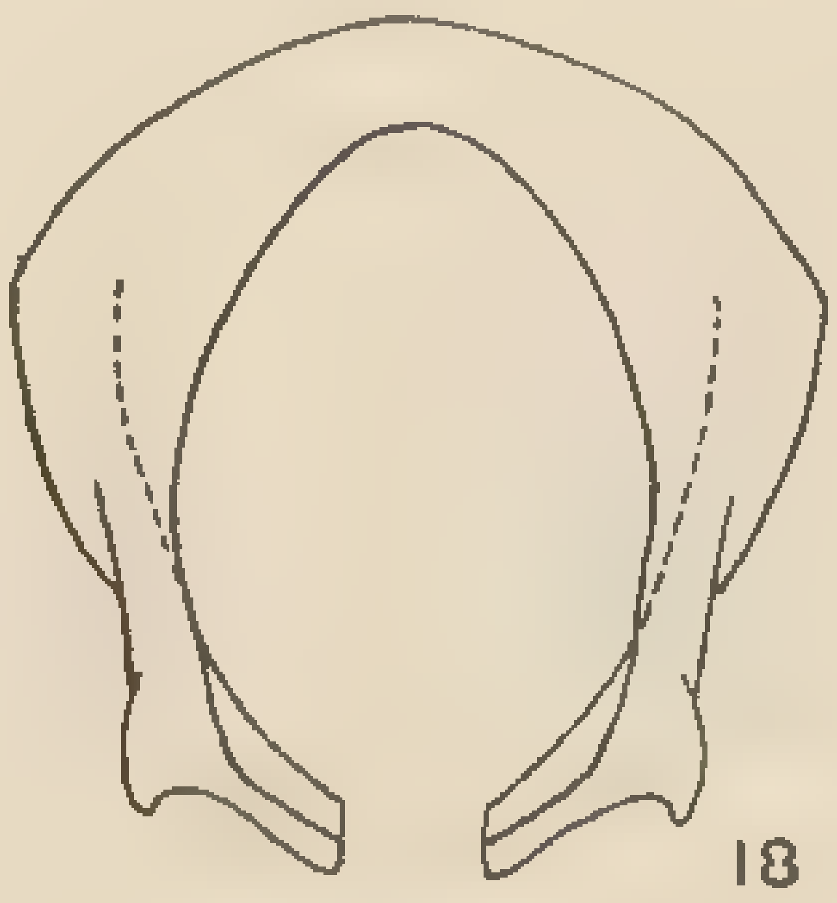
GARROTA



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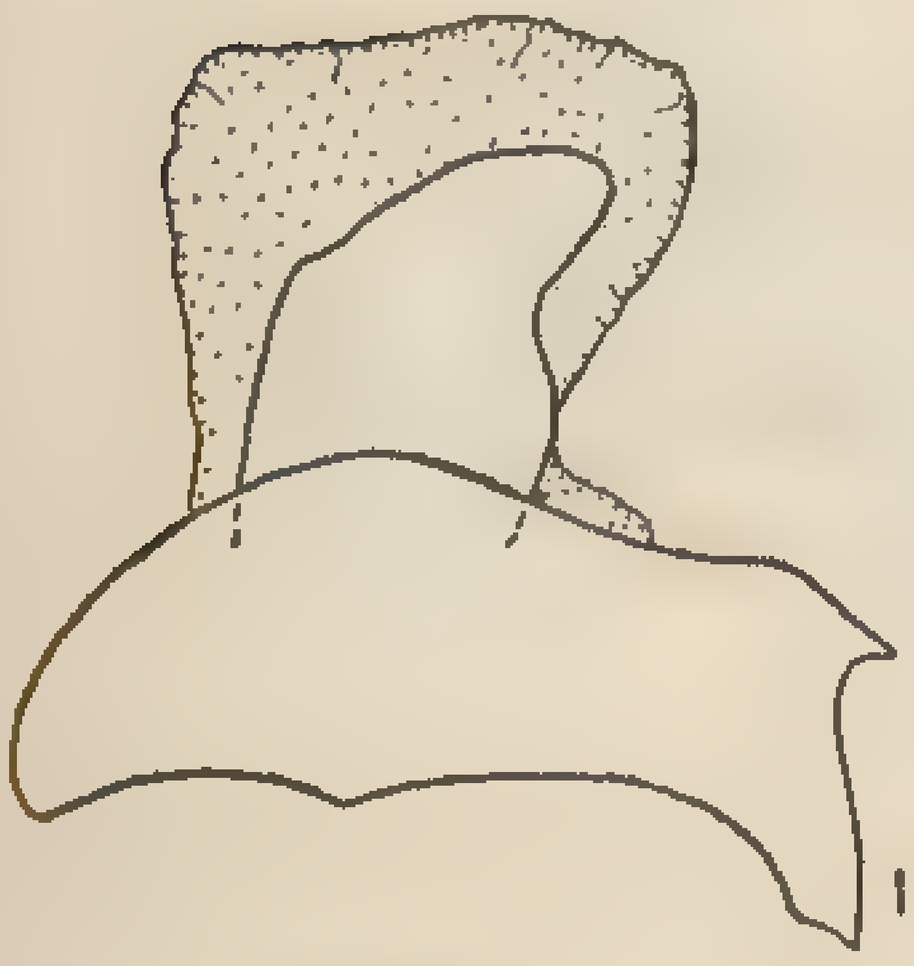
PROBAPORA



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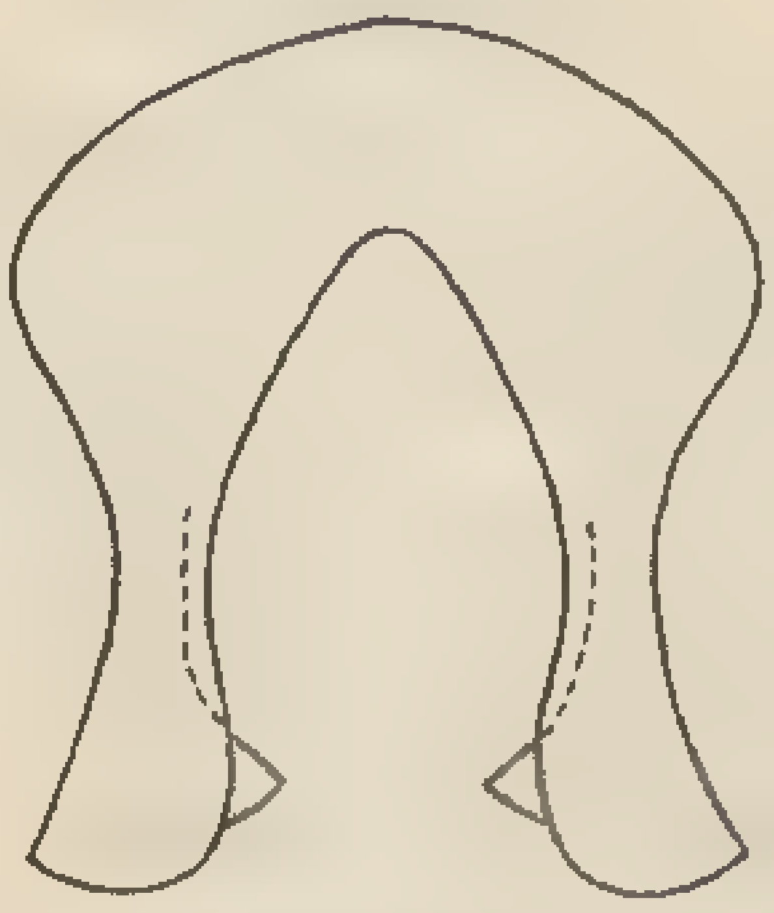
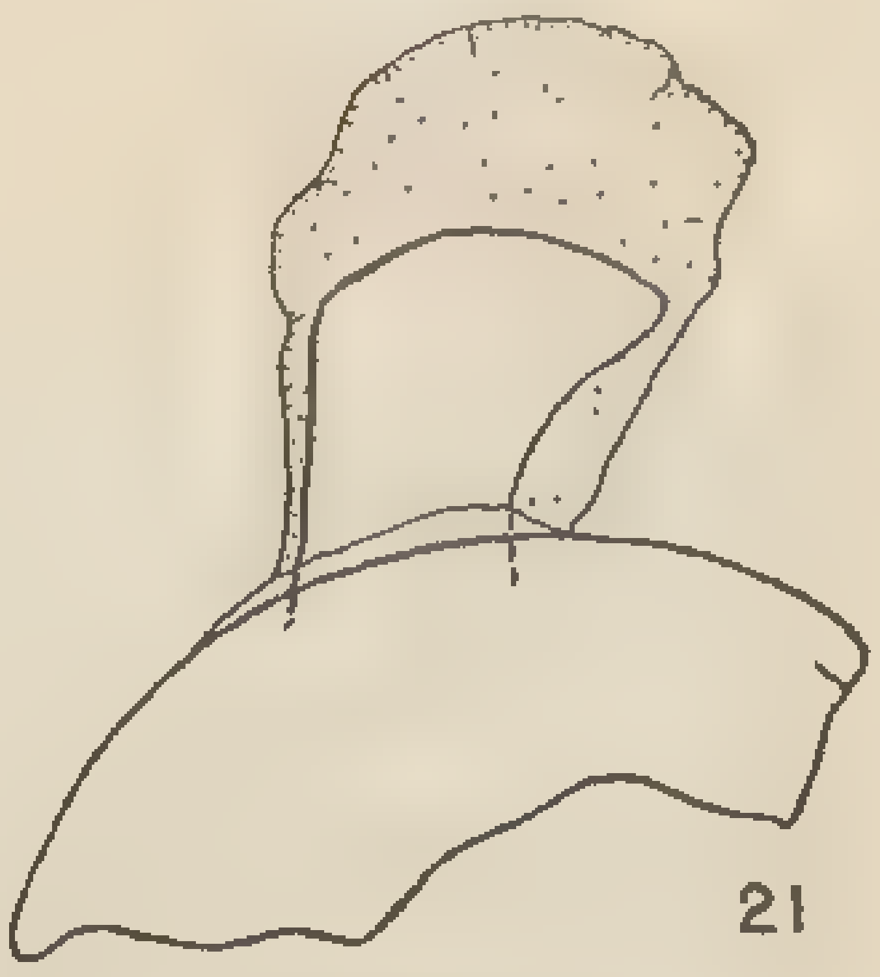
PROBAPORA



20

COSTURA



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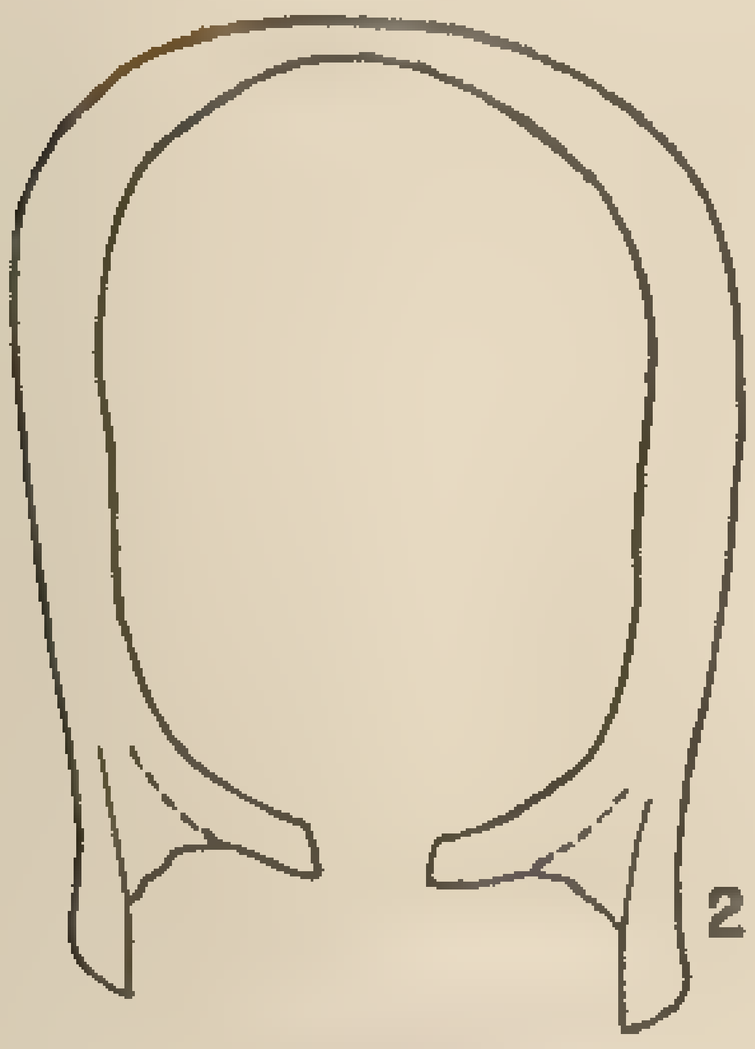
COSTURA



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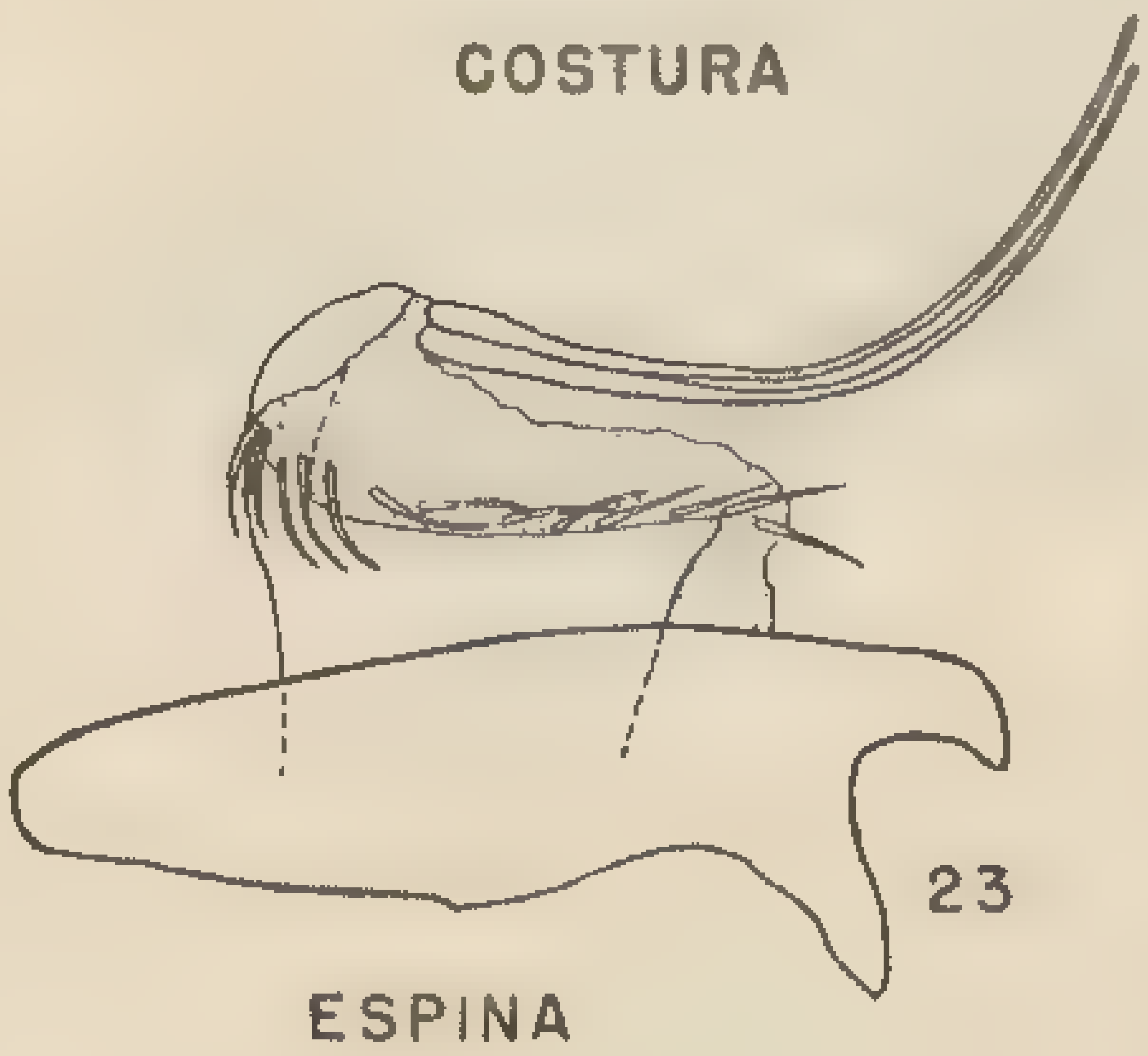
ESPINA



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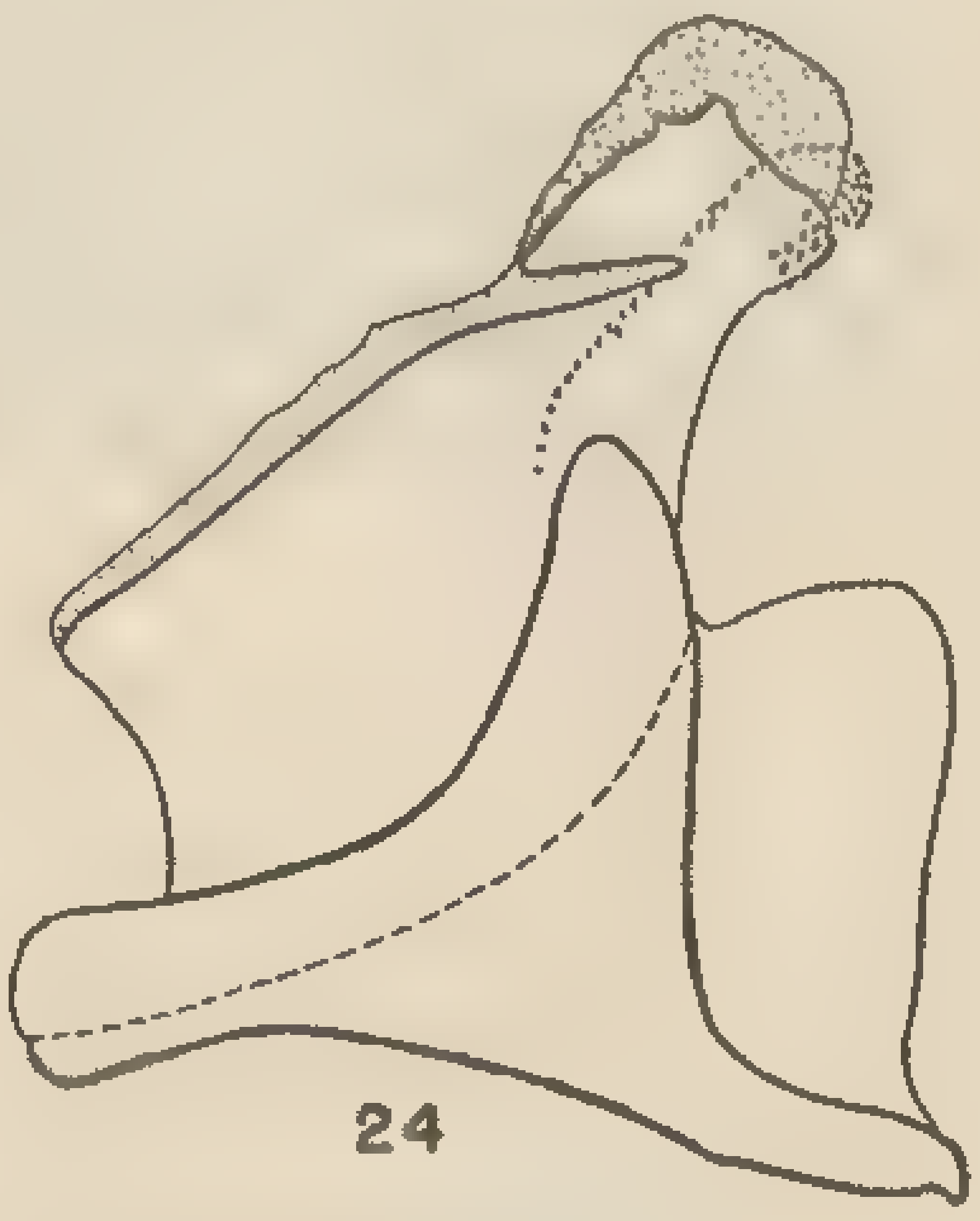
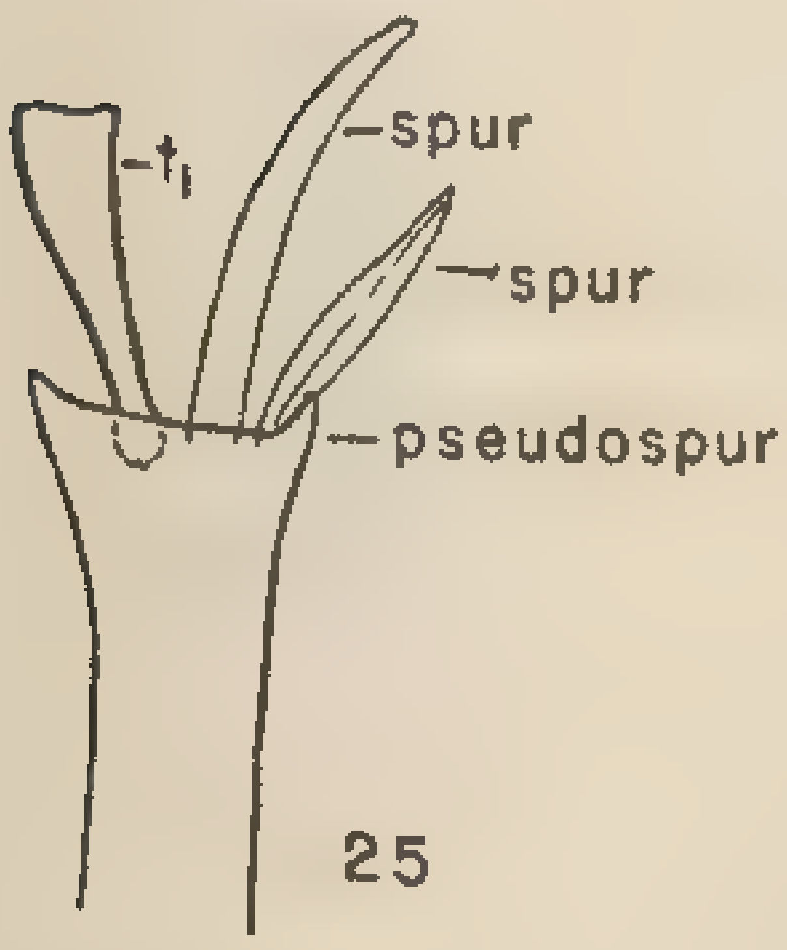
ESPINA



24

PSEUDOCALCARIS



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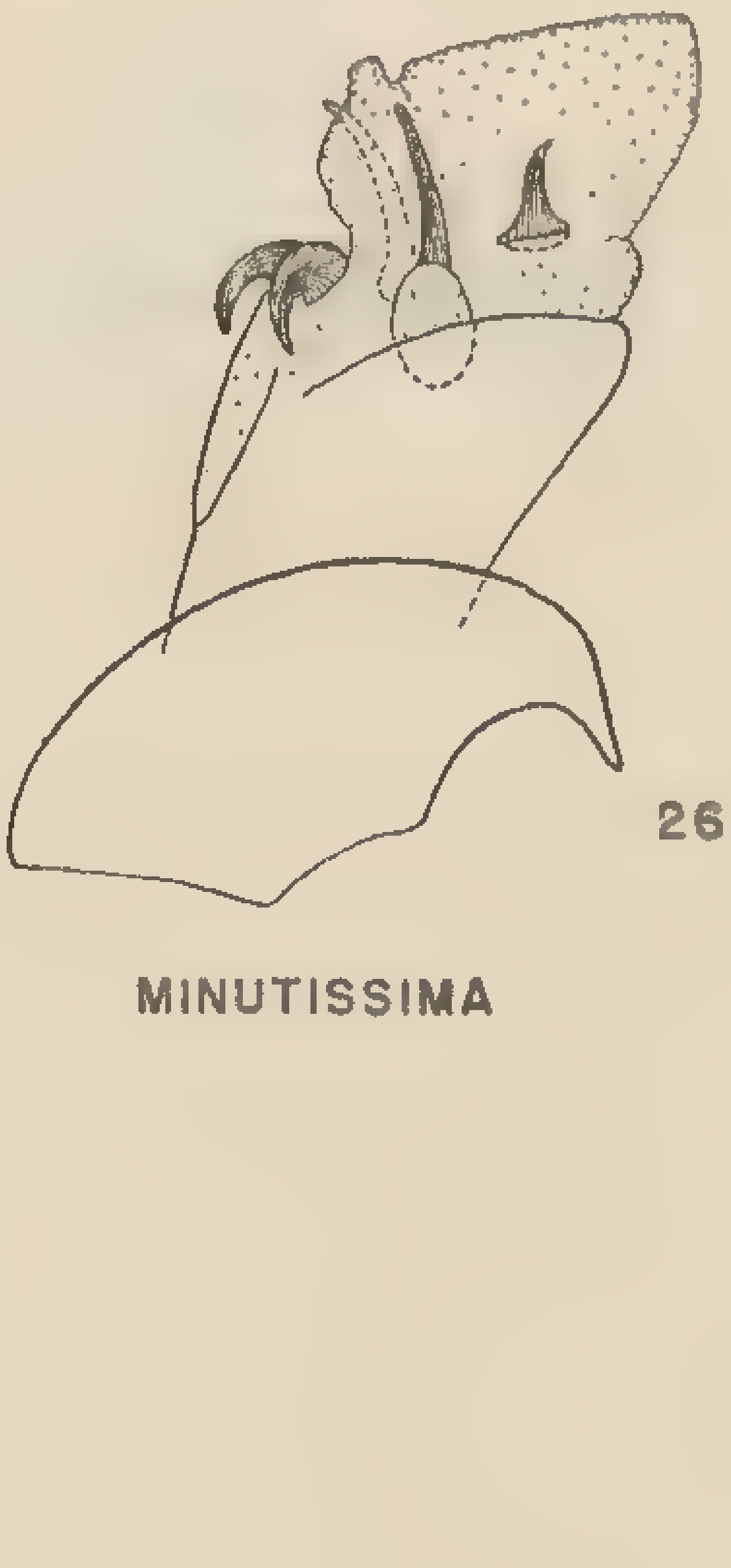
PSEUDOCALCARIS



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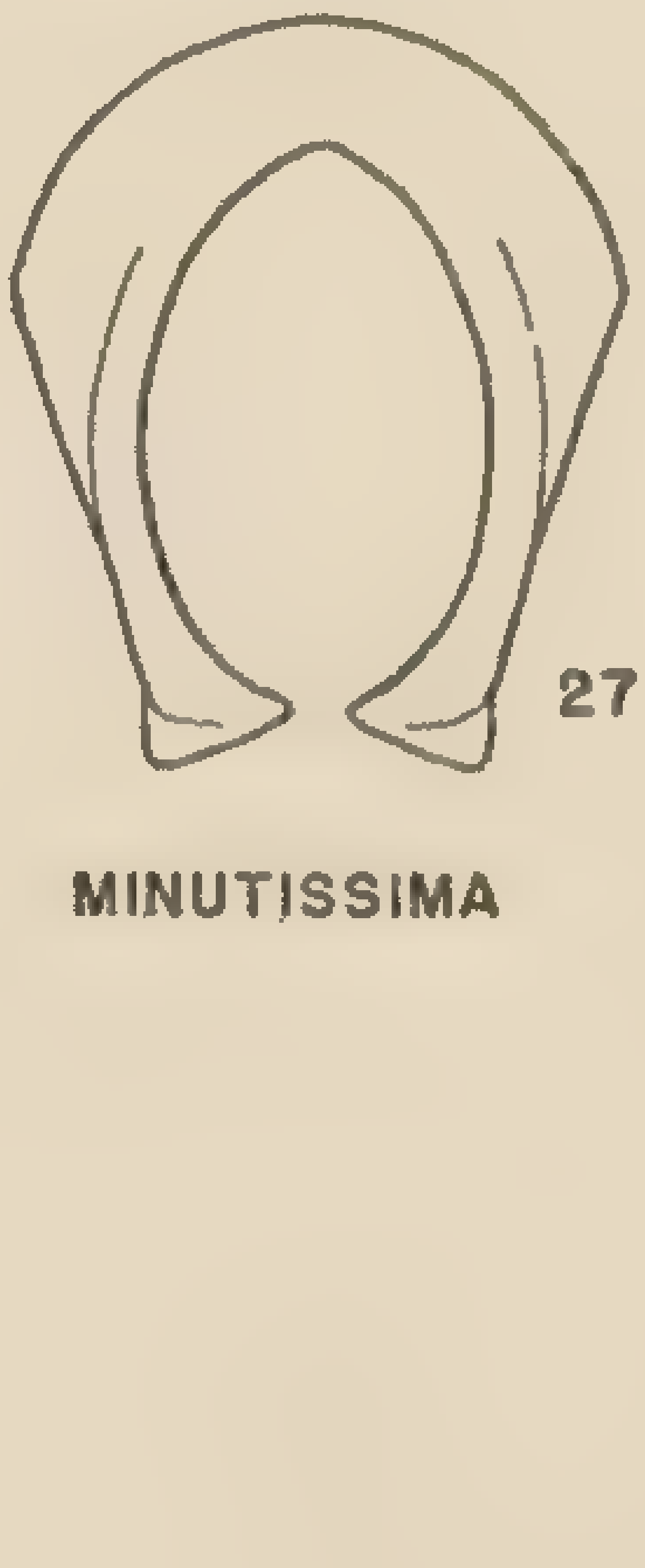
MINUTISSIMA



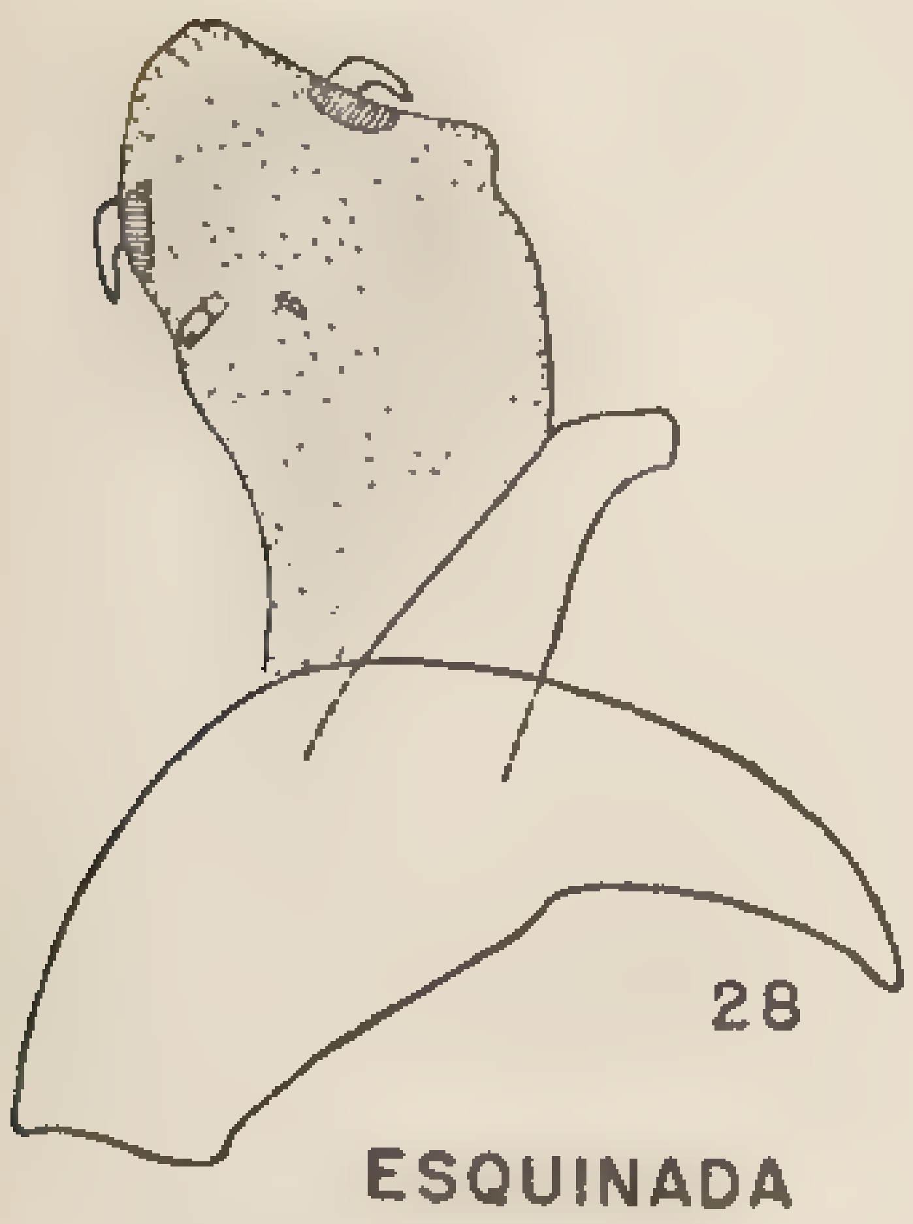
27

MINUTISSIMA

PLATE 3

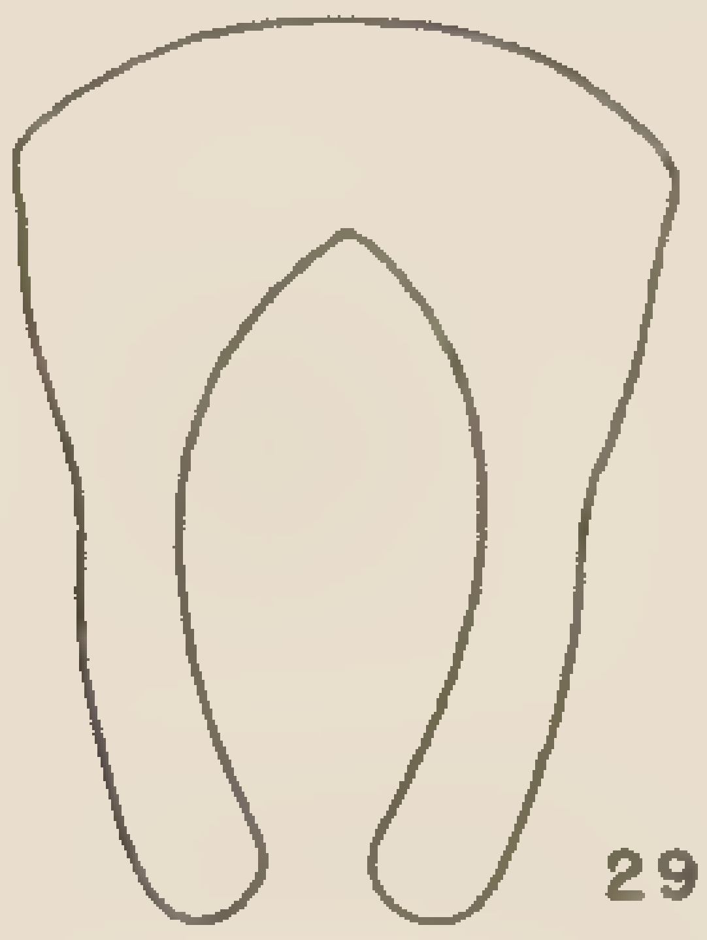
Phyllophaga spp.

Fig. 28. *esquinada* n. sp., male clasper and aedeagus, lateral.
Fig. 29. *esquinada* n. sp., male clasper, caudal.
Fig. 30. *esquinada* n. sp., male posterior tibia showing angled spur.
Fig. 31. *recorta* n. sp., male clasper and aedeagus, lateral.
Fig. 32. *recorta* n. sp., male clasper, caudal.
Fig. 33. *kenscoffi* Wolcott, male clasper, caudal.
Fig. 34. *kenscoffi* Wolcott, male clasper, lateral.
Fig. 35. *kenscoffi* Wolcott, male aedeagus, lateral.
Fig. 36. *kenscoffi* Wolcott, male aedeagus, caudal.
Fig. 37. *neglecta* (Blanchard), male aedeagus, caudal.
Fig. 38. *neglecta* (Blanchard), male clasper and aedeagus, lateral.
Fig. 39. *neglecta* (Blanchard), male clasper, caudal.



28

ESQUINADA



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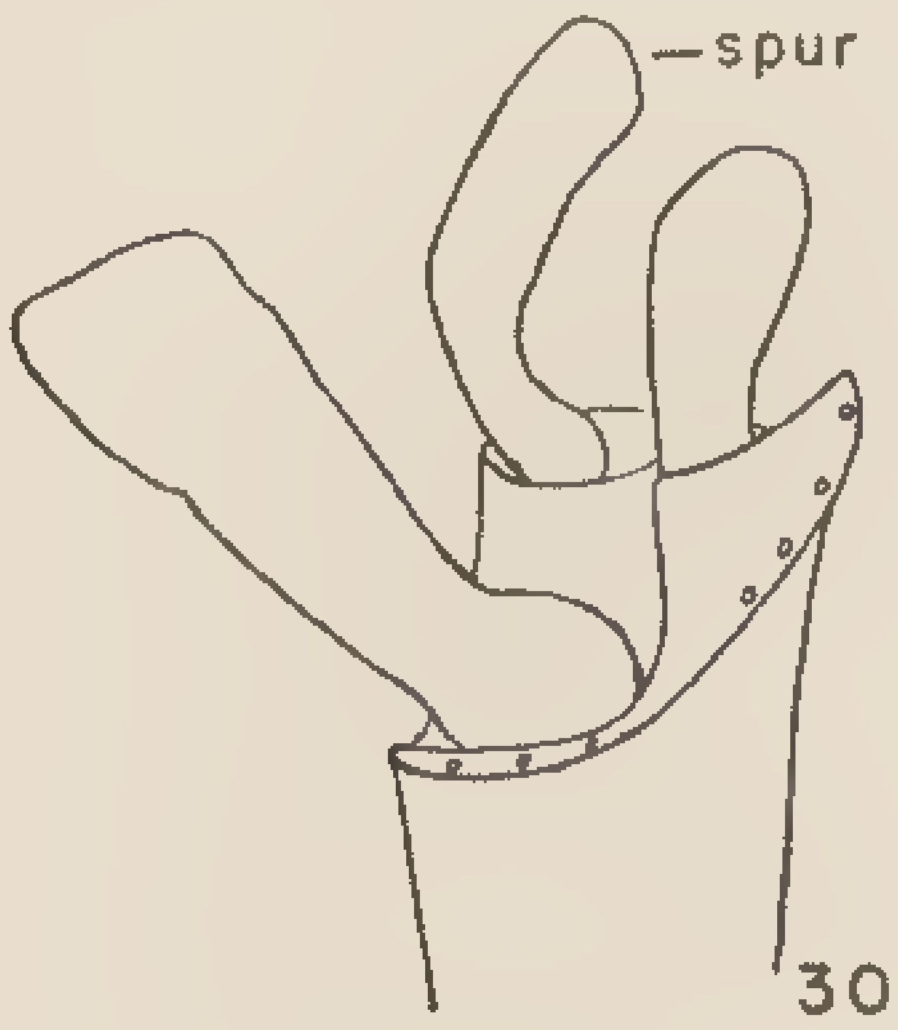
ESQUINADA



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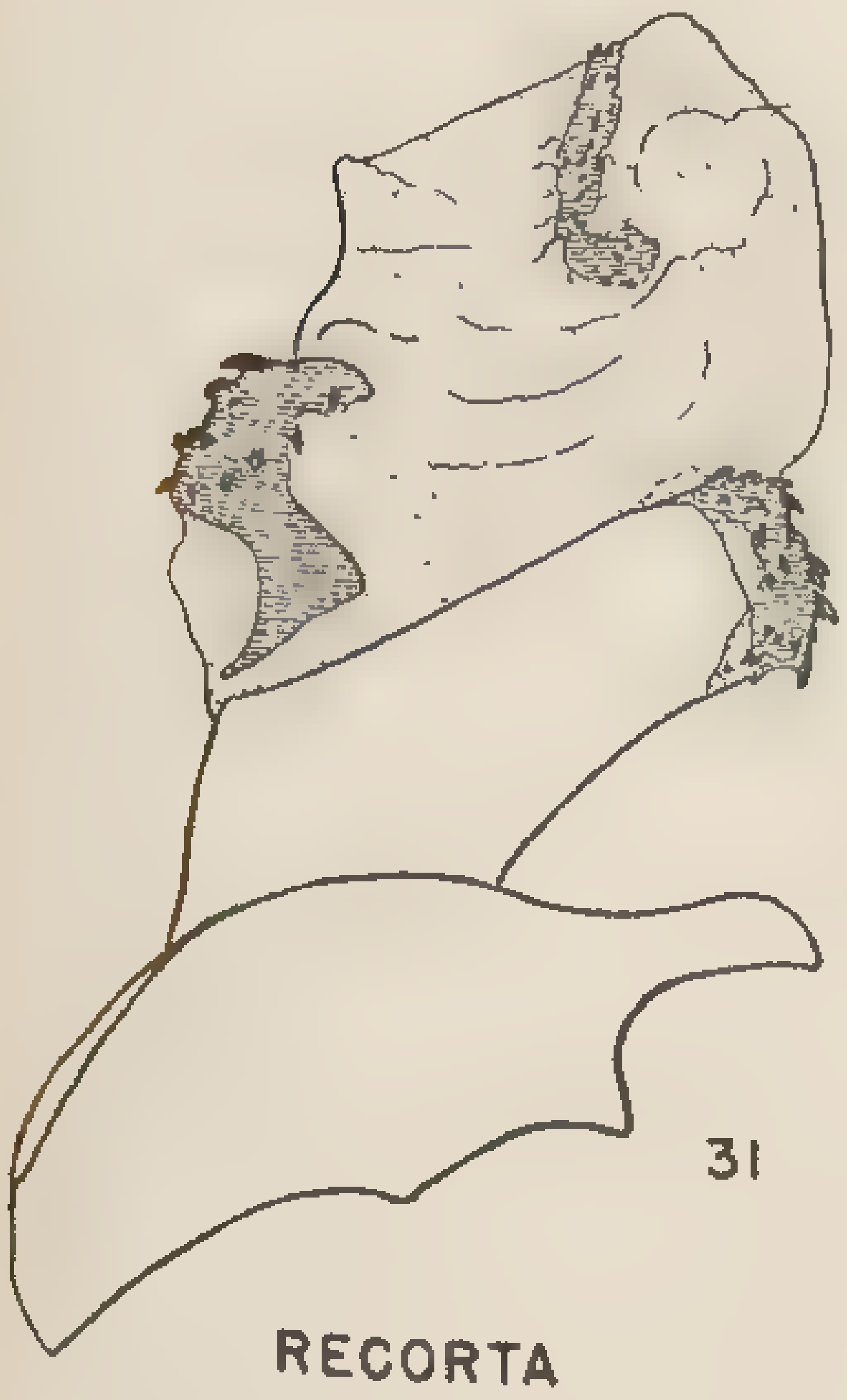
ESQUINADA



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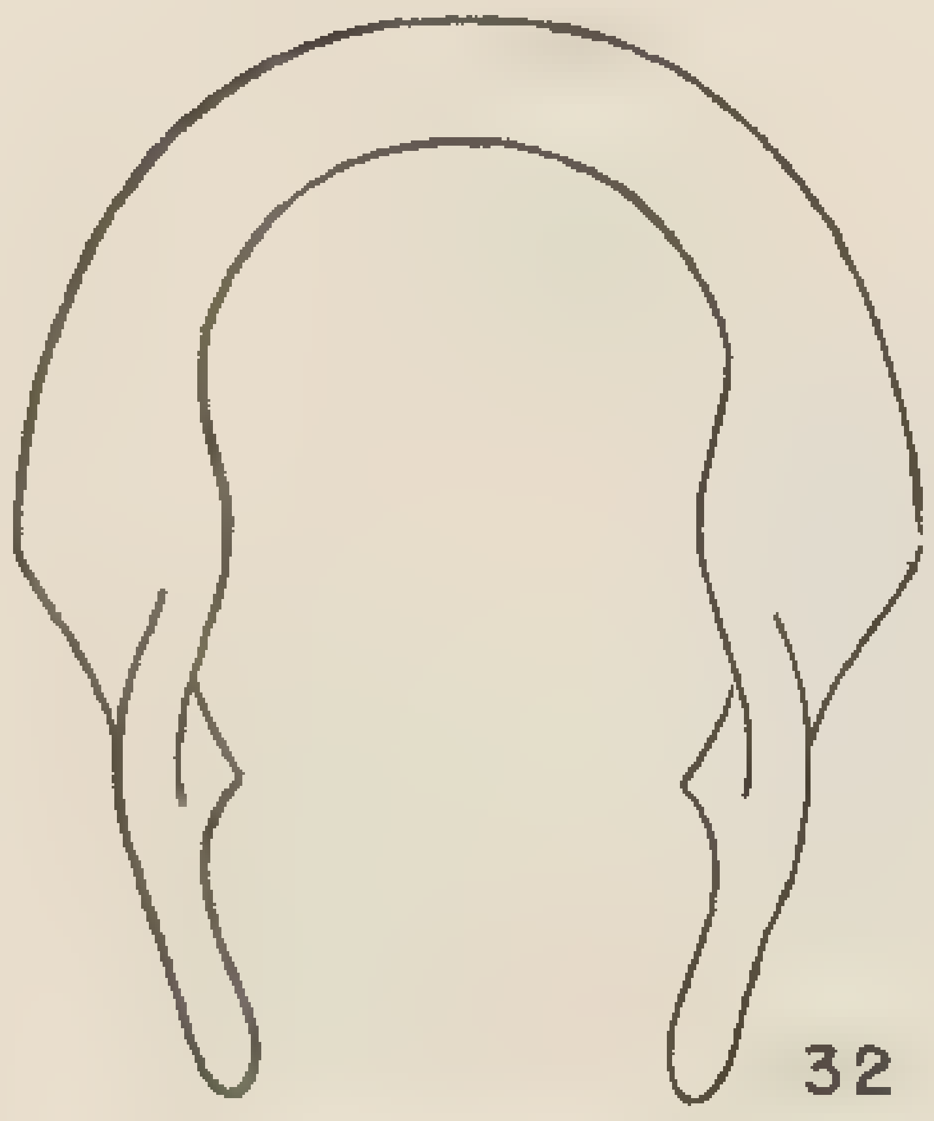
RECORTA



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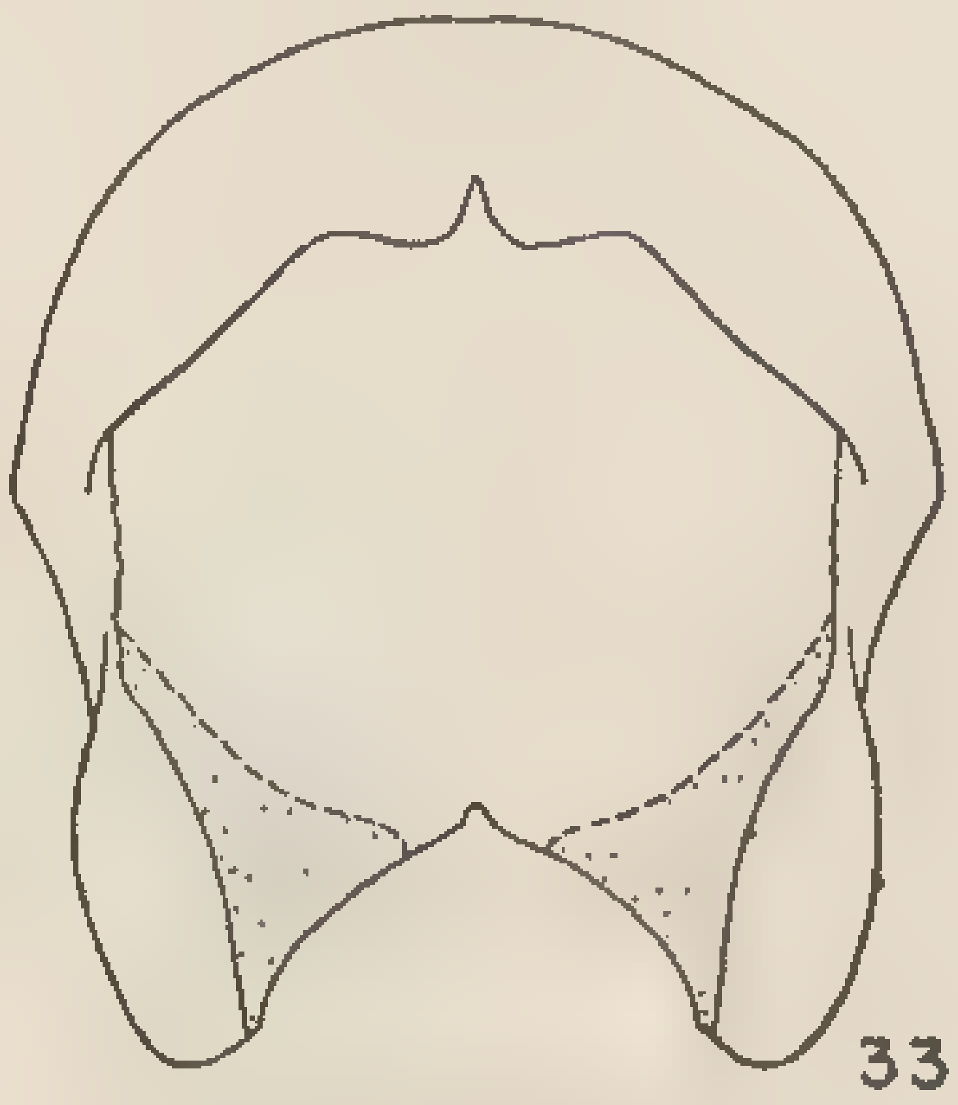
RECORTA



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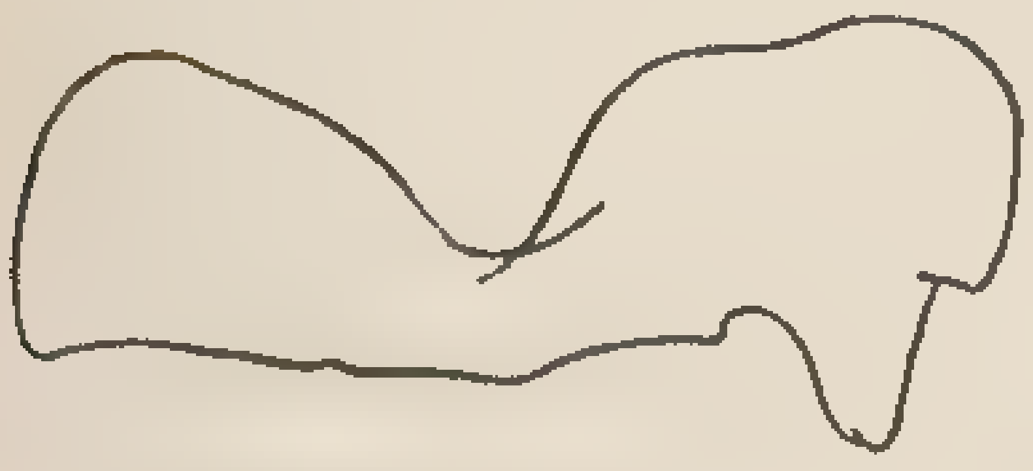
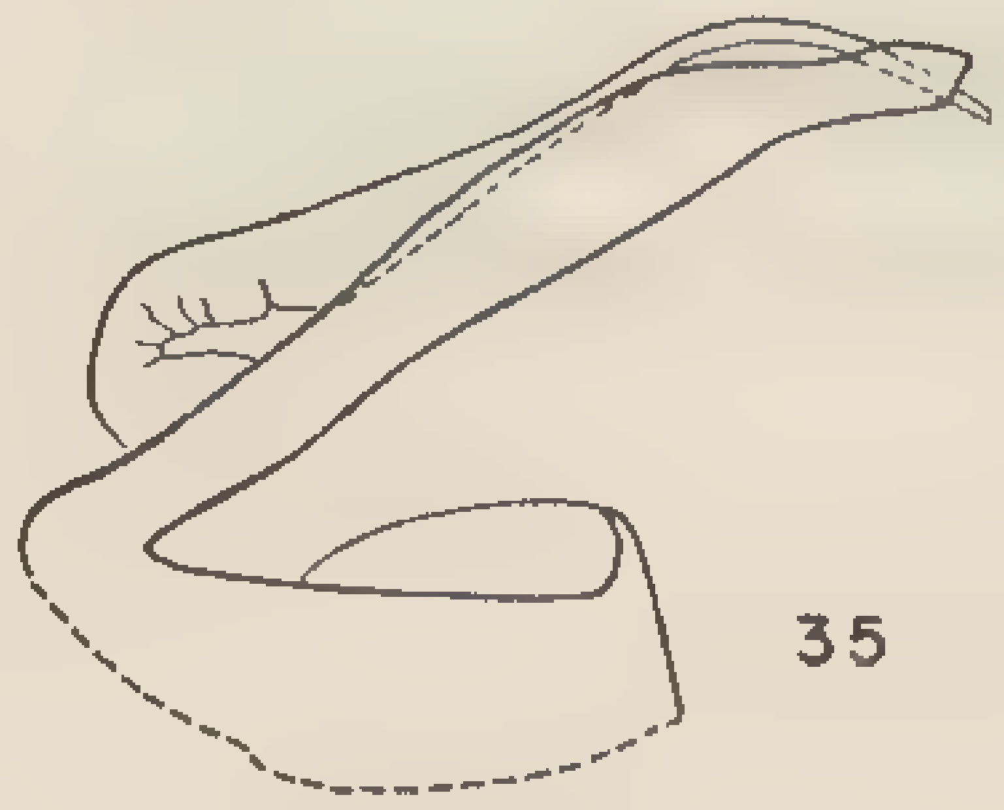
KENSCOFFI



KENSCOFFI 34



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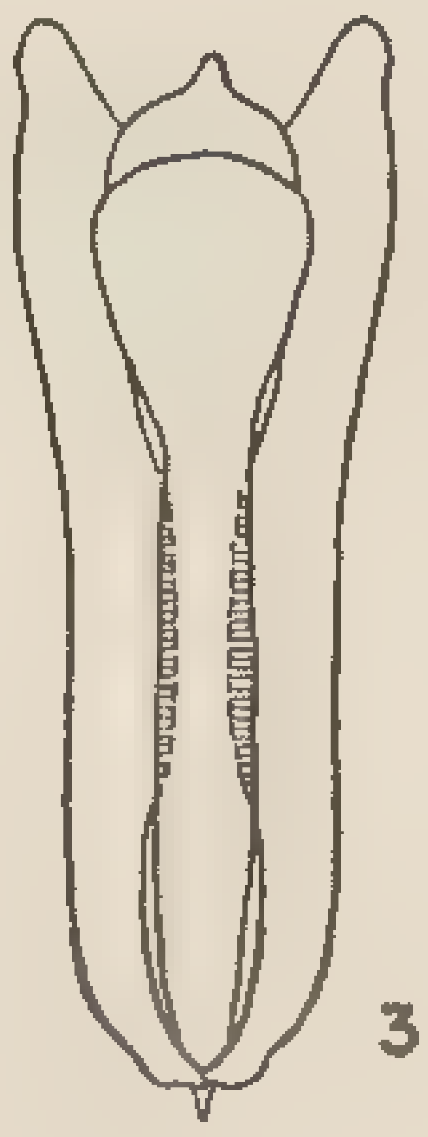

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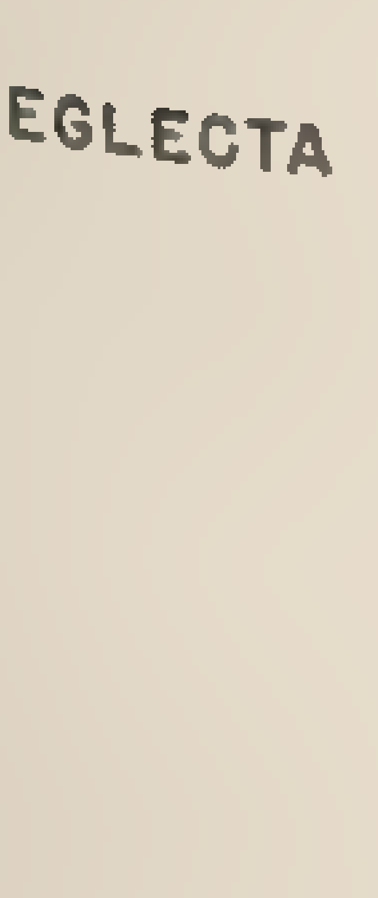

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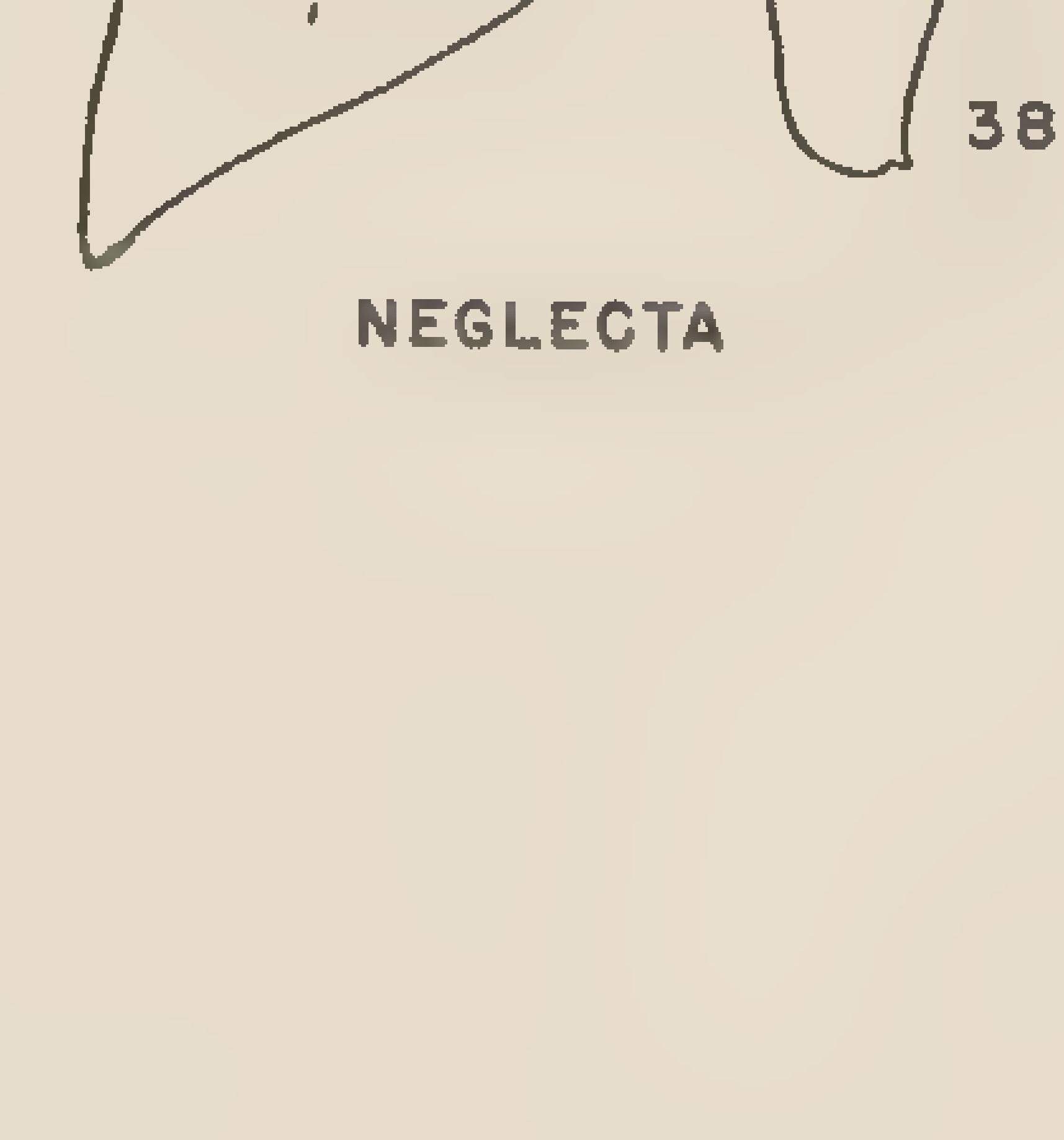
NEGLECTA



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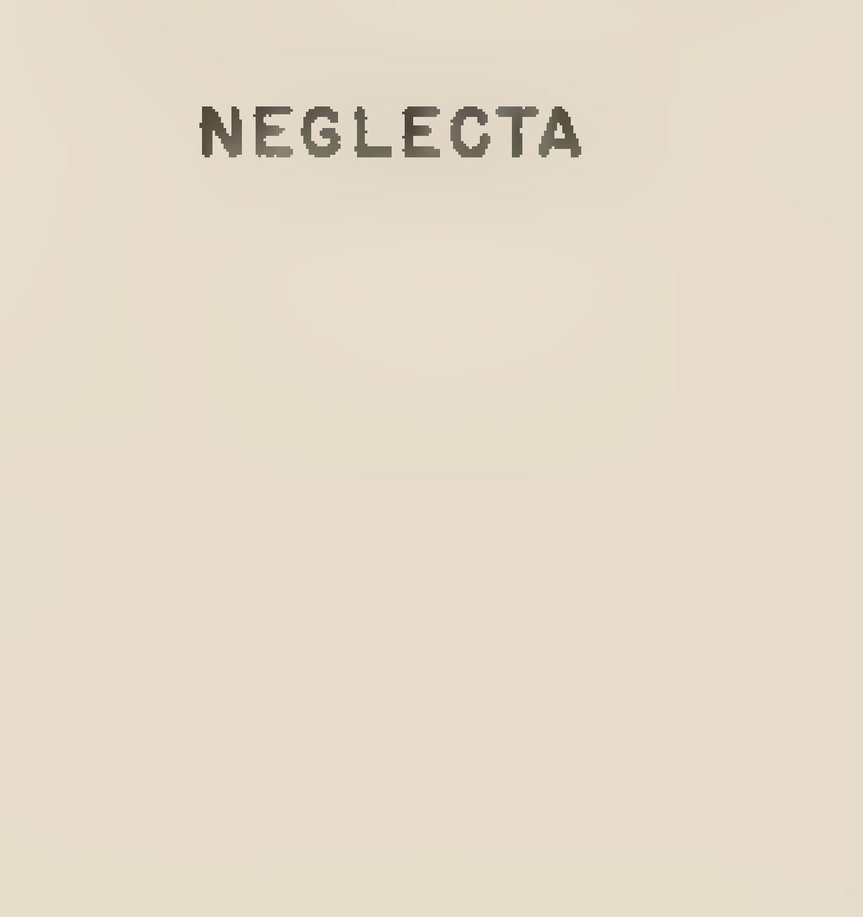
NEGLECTA



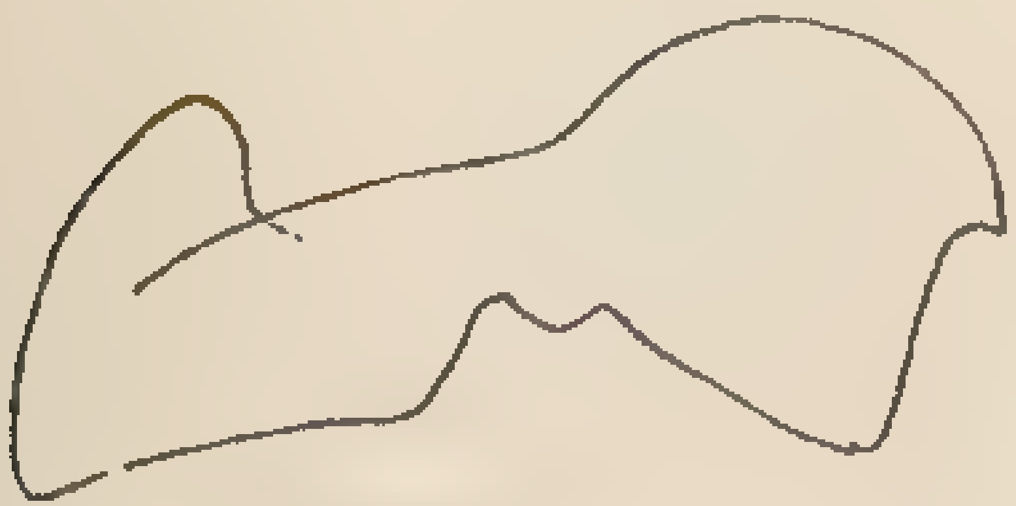
39

NEGLECTA

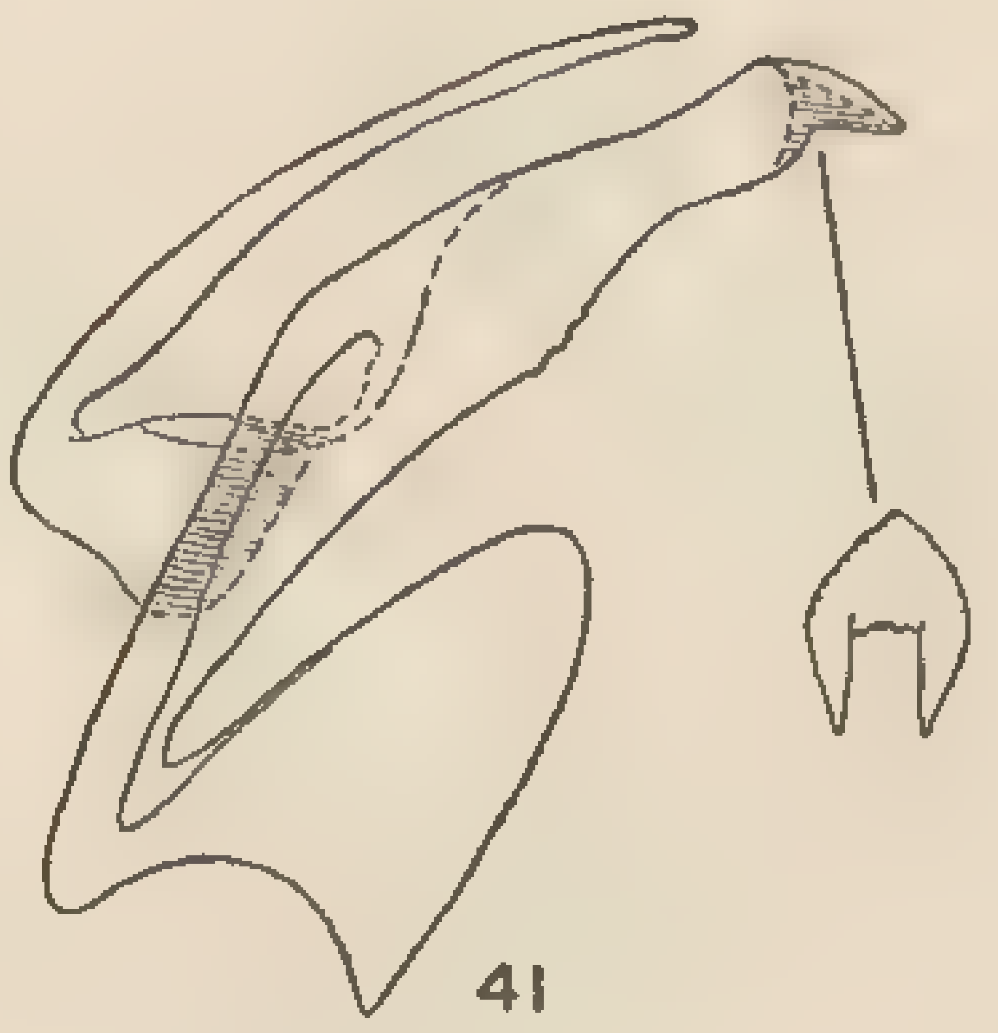
PLATE 4

Phyllophaga spp.

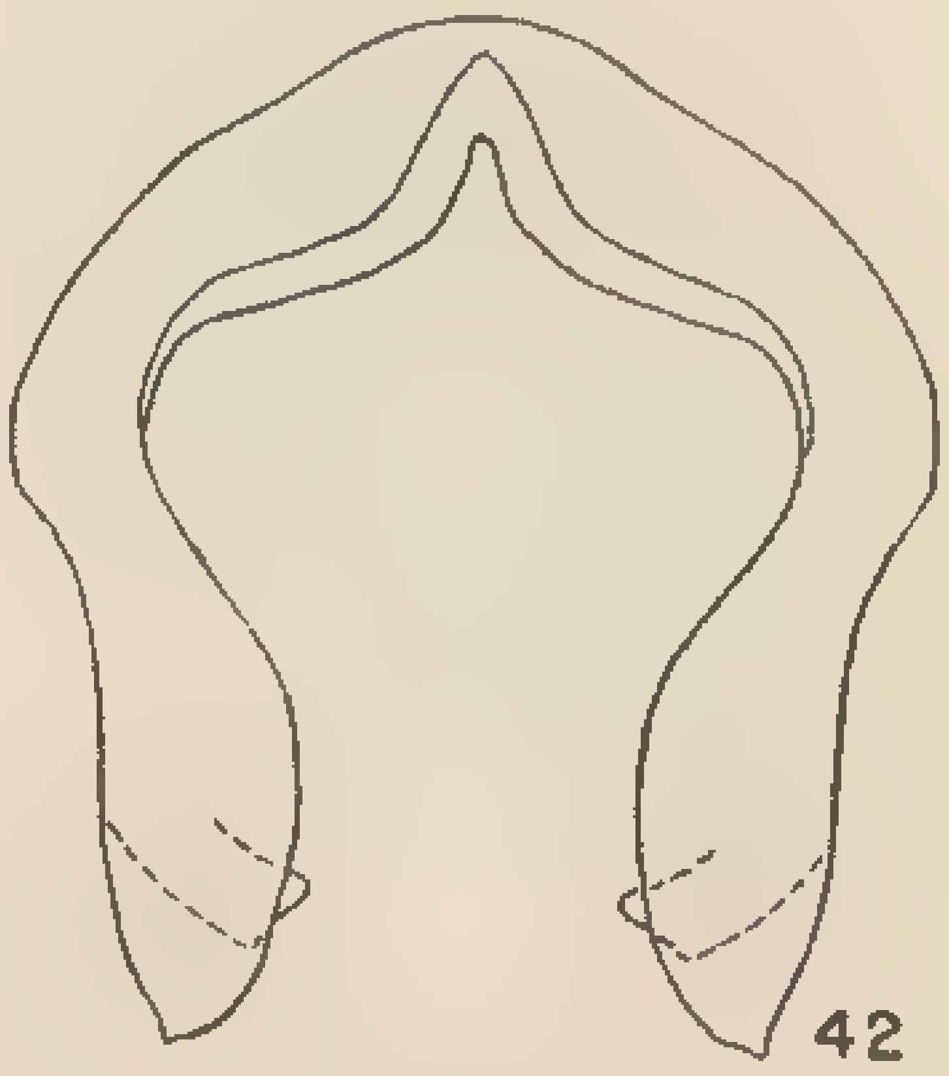
Fig. 40. *mali* Wolcott, male clasper (type locality), lateral.
Fig. 41. *mali* Wolcott, male aedeagus (type locality), lateral.
Fig. 42. *mali* Wolcott, male clasper (type locality), caudal.
Fig. 43. *mali* Wolcott, male aedeagus, lateral, showing variation.
Fig. 44. *audanti* Wolcott, male clasper and aedeagus, lateral.
Fig. 45. *audanti* Wolcott, male clasper, caudal.
Fig. 46. *cartaba* n. sp., male clasper and aedeagus, lateral.
Fig. 47. *cartaba* n. sp., male clasper, caudal.
Fig. 48. *panicula* n. sp., male clasper, lateral.
Fig. 49. *latiungula* Wolcott, male clasper and aedeagus, lateral.
Fig. 50. *latiungula* Wolcott, male clasper, caudal.
Fig. 51. *panicula* n. sp., male clasper, caudal.



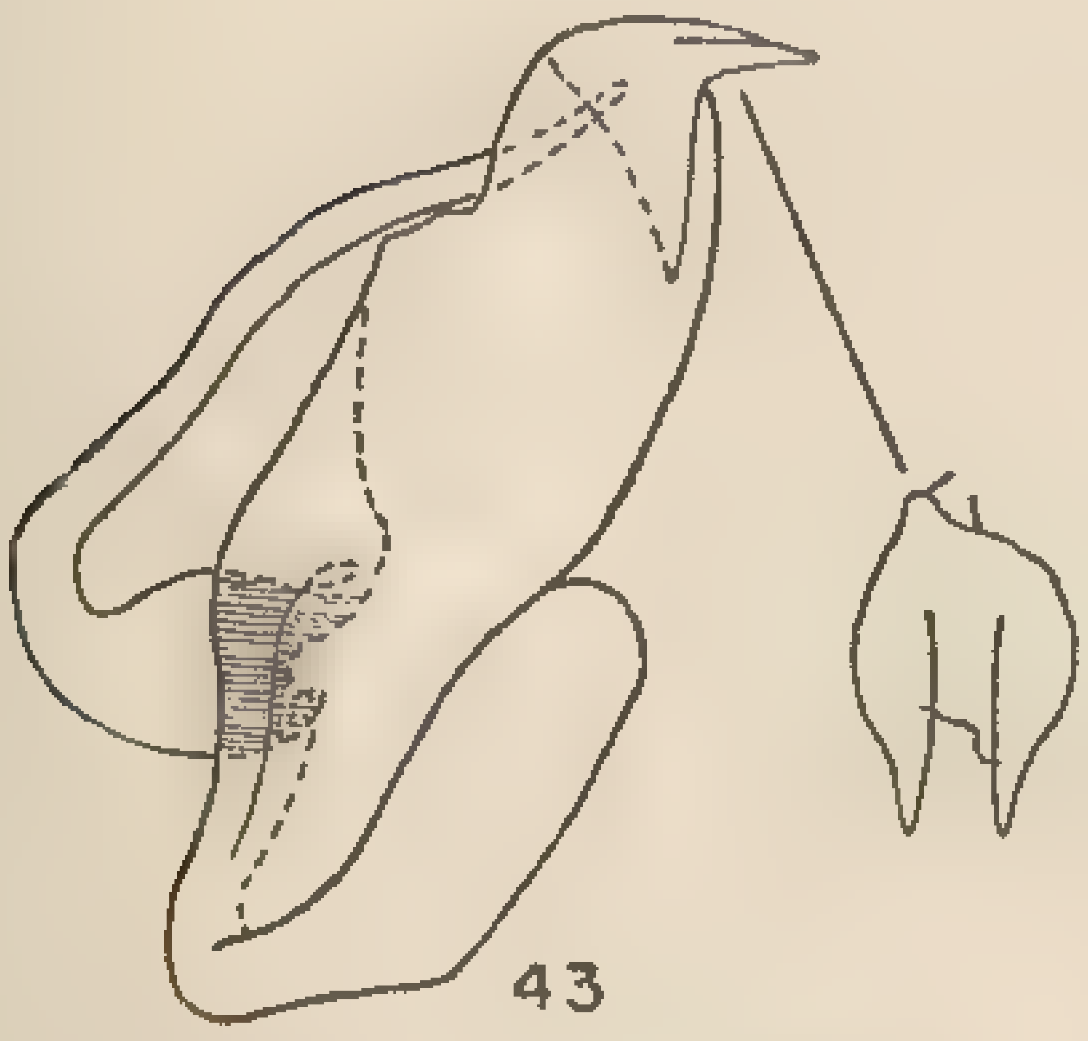
MALI 40



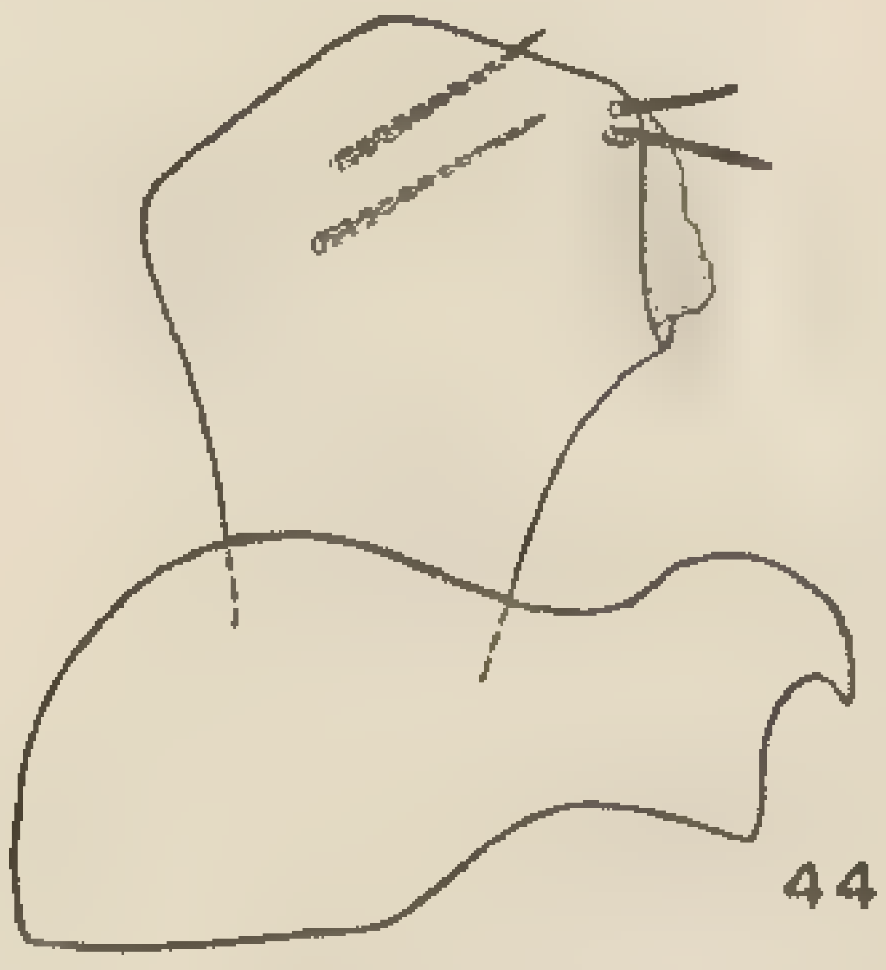
MALI 41



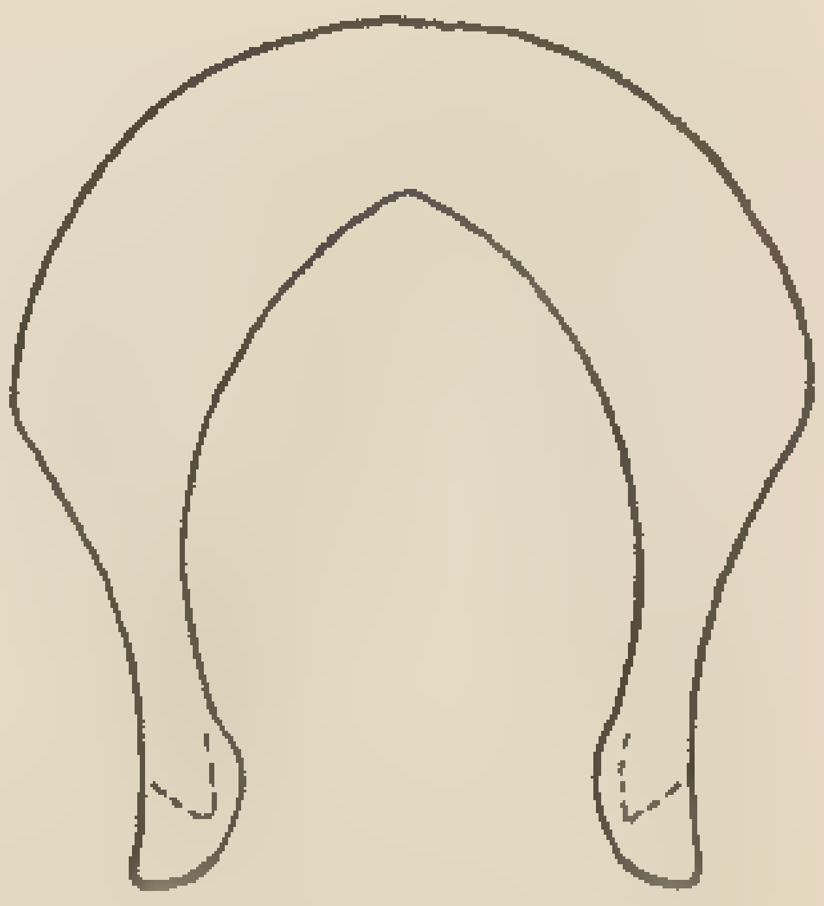
MALI 42



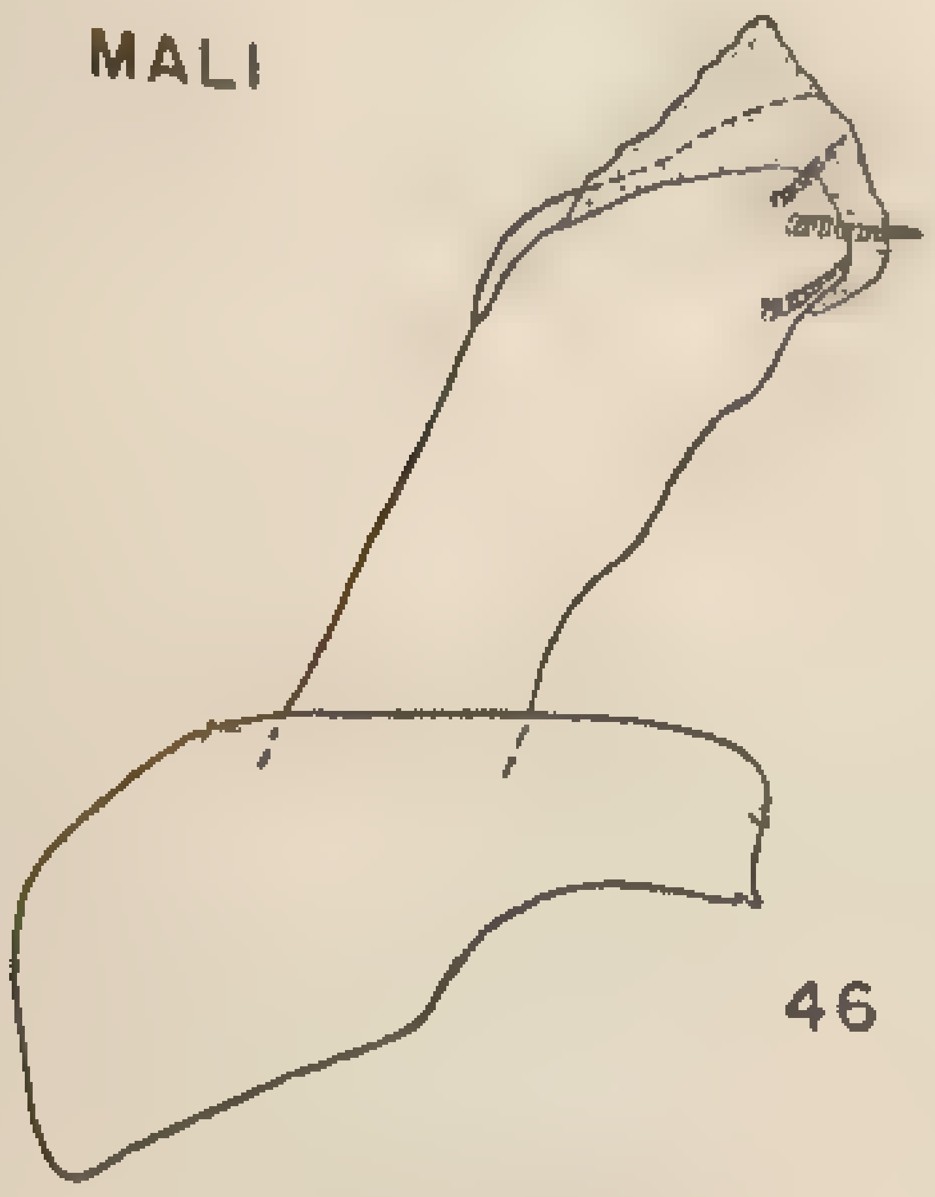
MALI 43



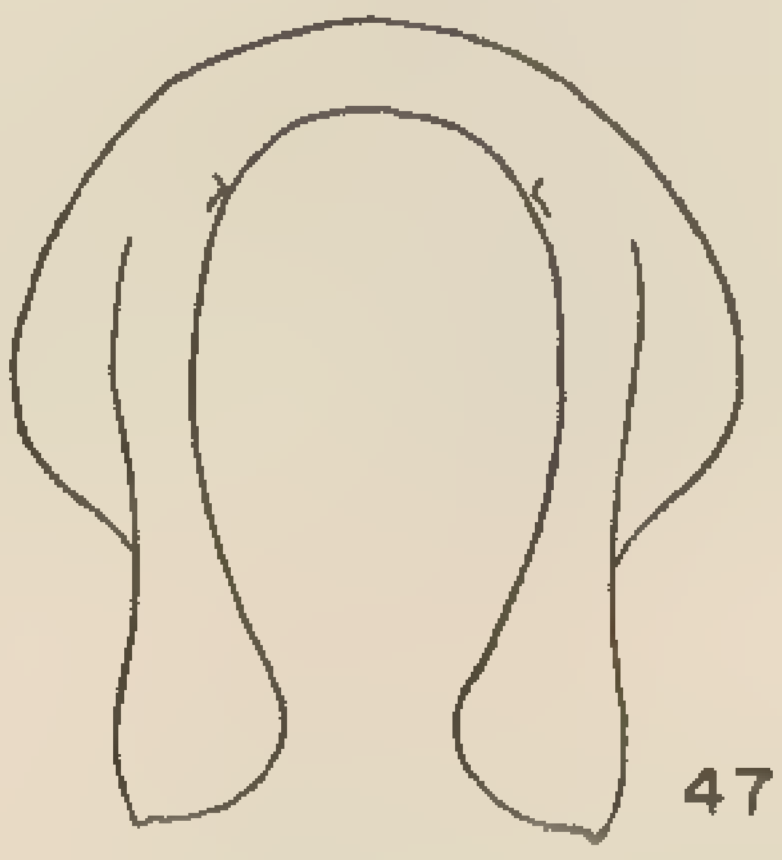
AUDANTI 44



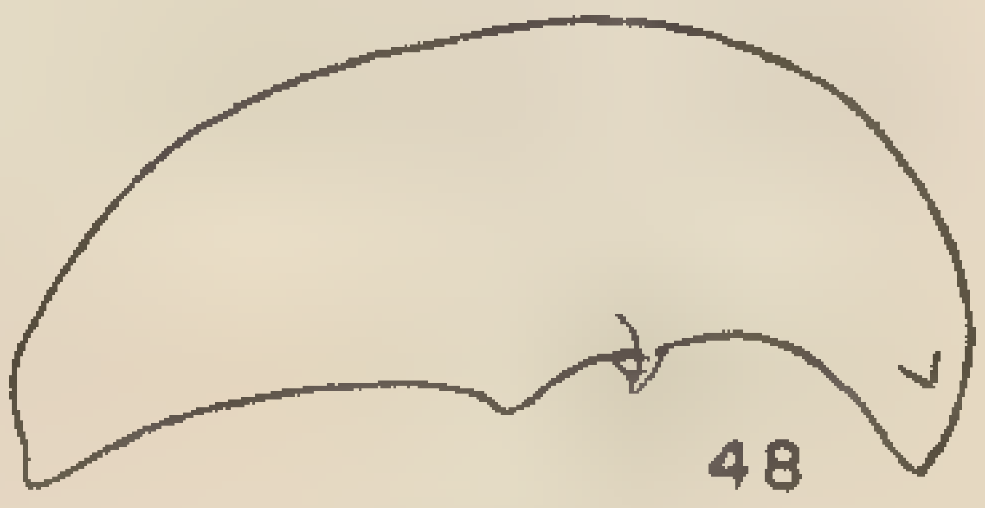
AUDANTI 45



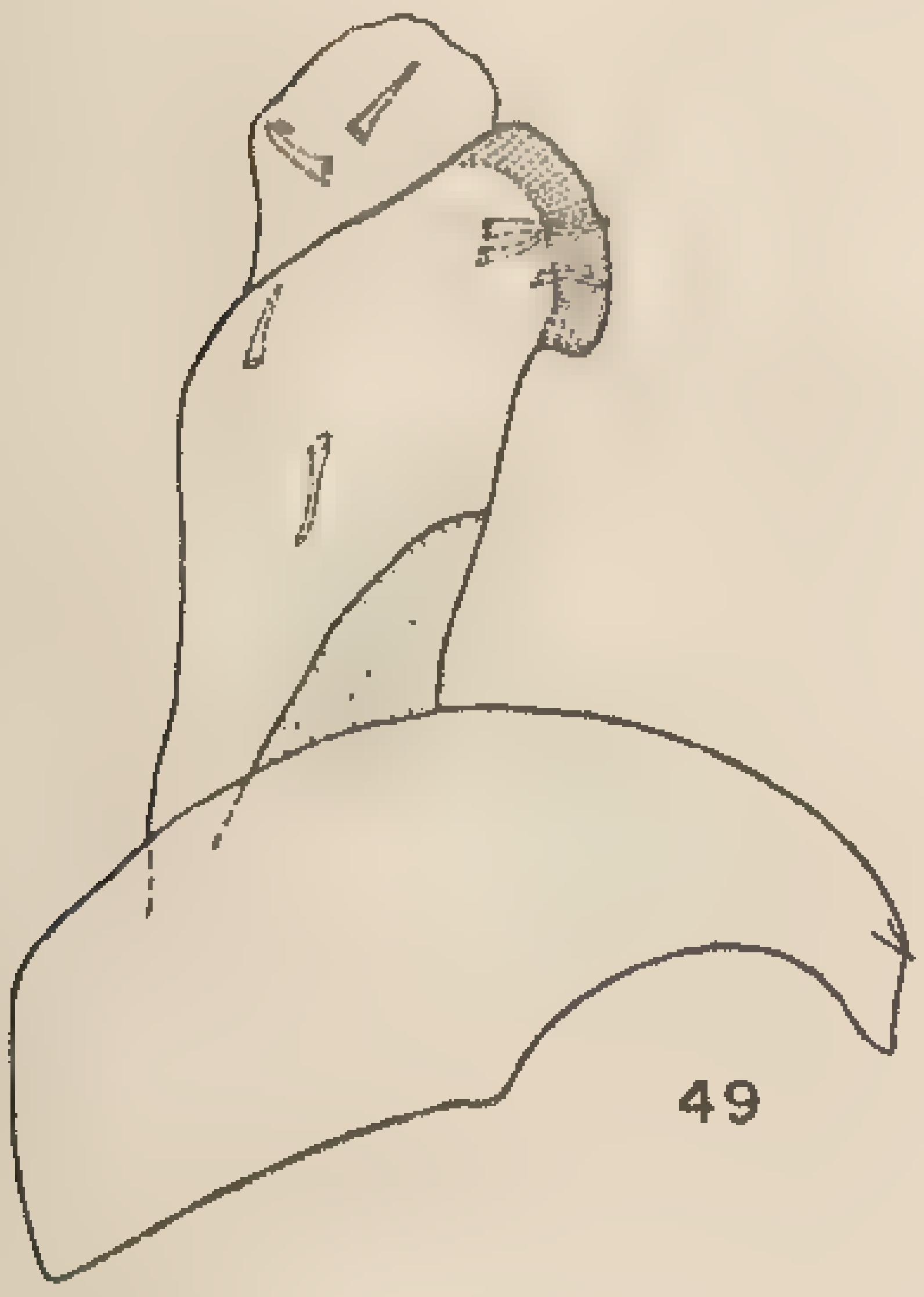
CARTABA 46



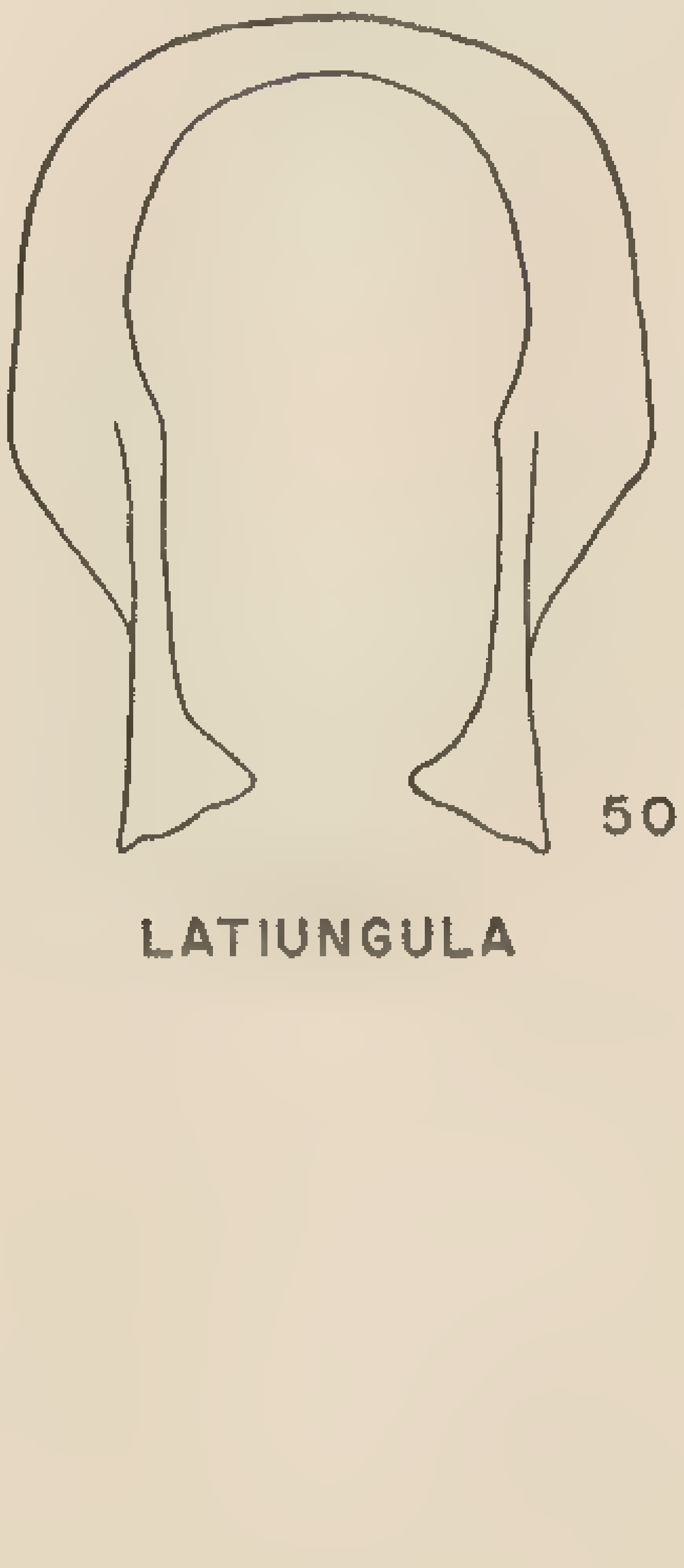
CARTABA 47



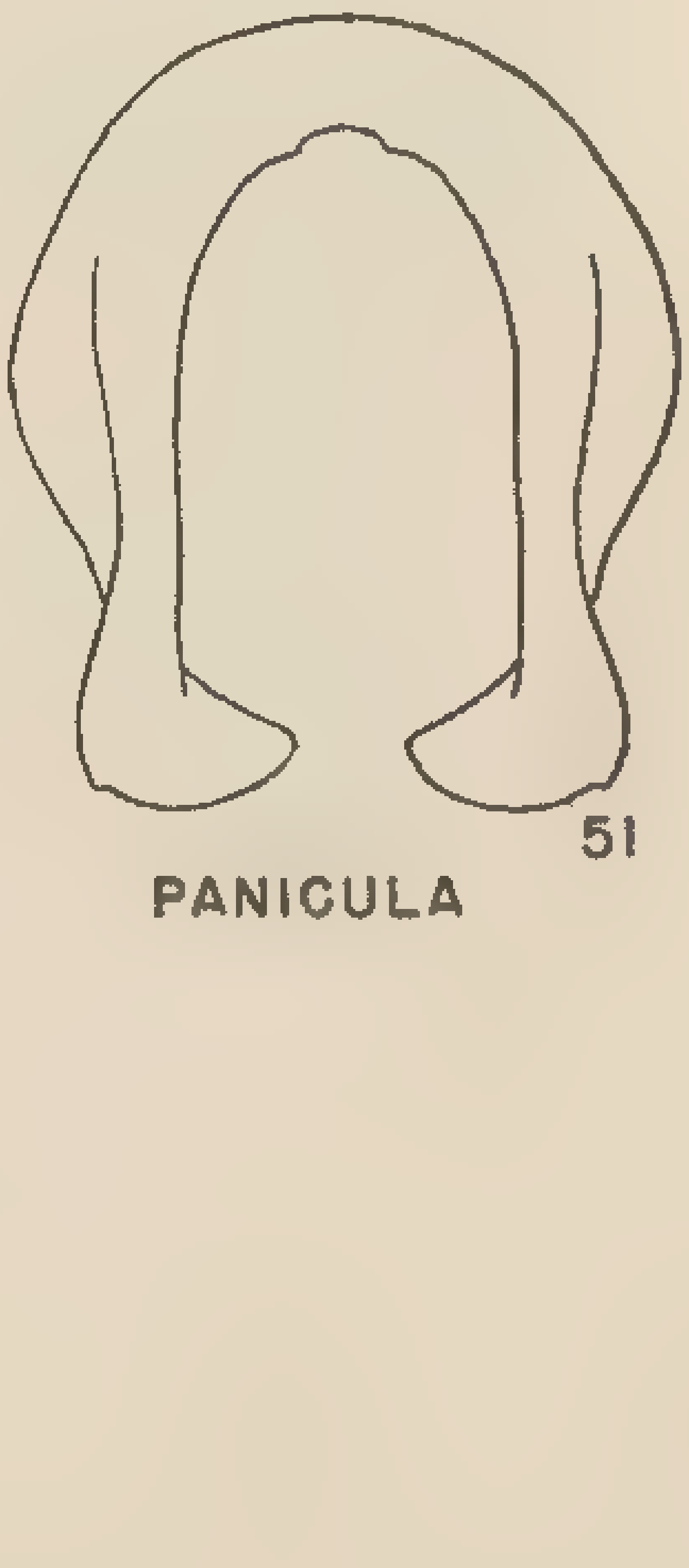
PANICULA 48



LATIUNGULA 49



LATIUNGULA 50

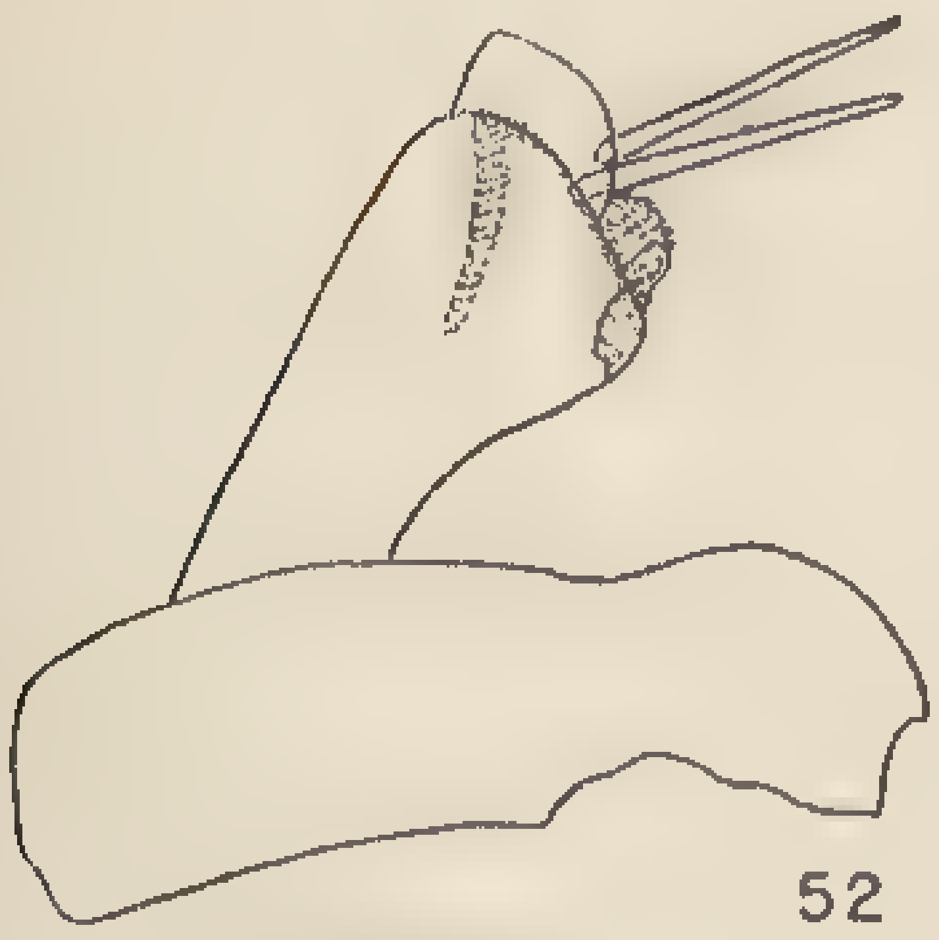


PANICULA 51

PLATE 5

Phyllophaga spp.

Fig. 52. *imprima* n. sp., male clasper and aedeagus, lateral.
Fig. 53. *imprima* n. sp., male clasper, caudal.
Fig. 54. *mella* n. sp., male aedeagus, lateral.
Fig. 55. *mella* n. sp., male clasper, caudal.
Fig. 56. *mella* n. sp., male clasper, lateral.
Fig. 57. *aliada* n. sp., female tarsal claw.
Fig. 58. *aliada* n. sp., female clypeus.
Fig. 59. *aliada* n. sp., female genitalia.
Fig. 60. *canoa* n. sp., female genitalia.
Fig. 61. *hogardi* (Blanchard), female pubic process.
Fig. 62. *permagna* (Moser), female pubic process.
Fig. 63. *romana* (Saylor), female pubic process.
Fig. 64. *leptospica* n. sp., female pubic process.
Fig. 65. *pseudocalcaris* Saylor, female genitalia.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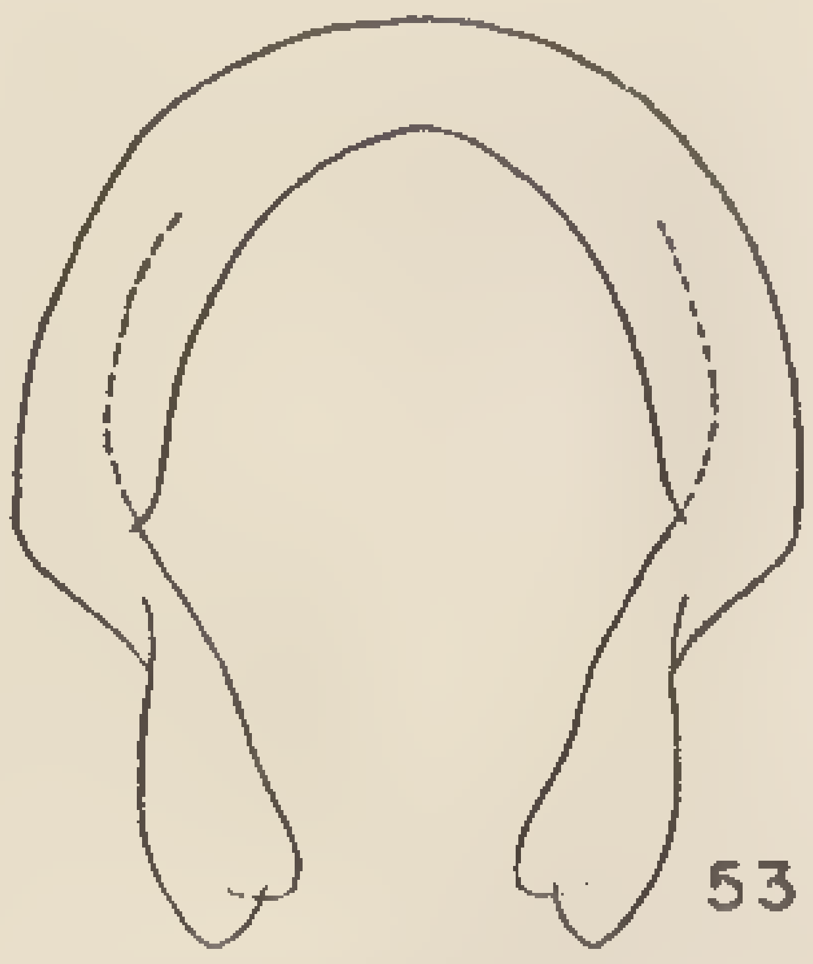
IMPRIMA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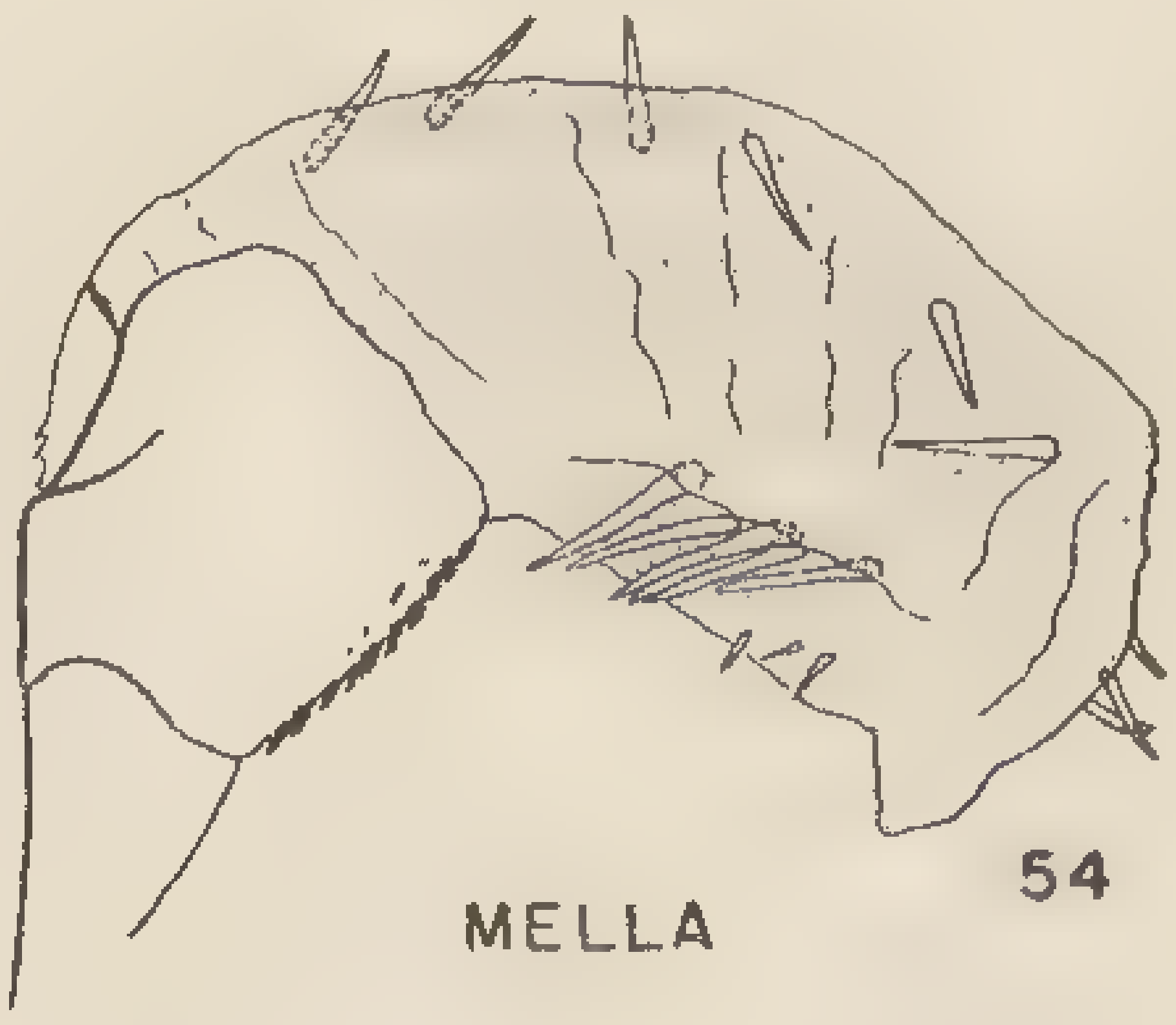
IMPRIMA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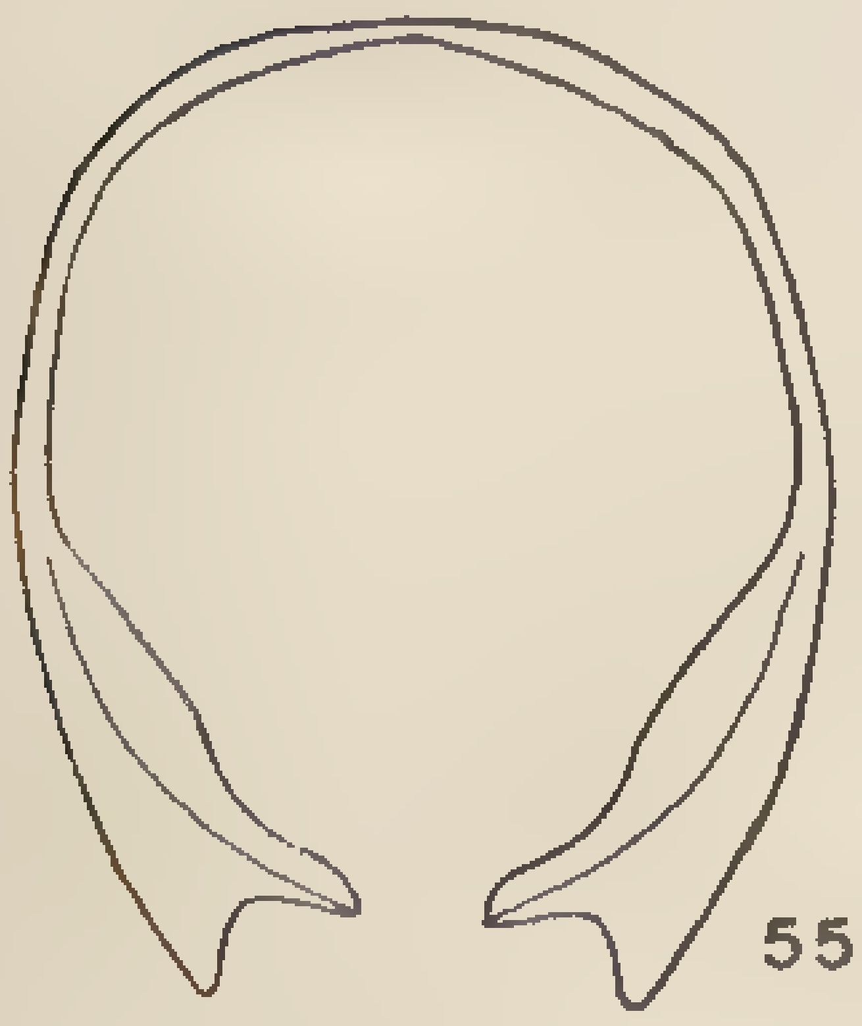
MELLA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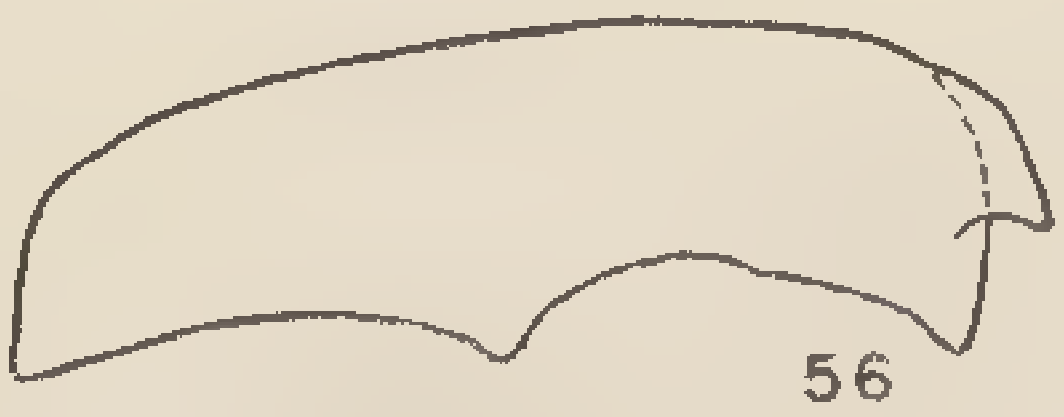
MELLA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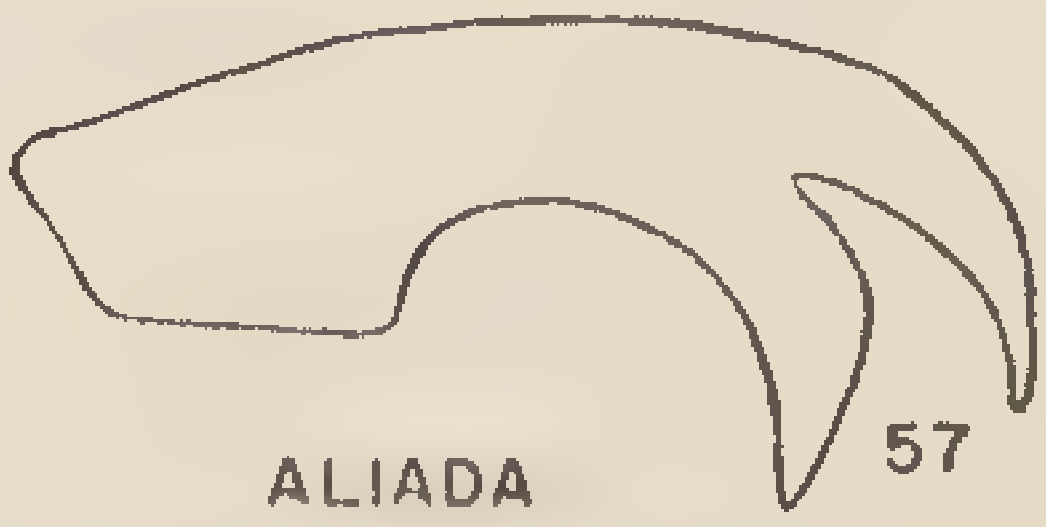
MELLA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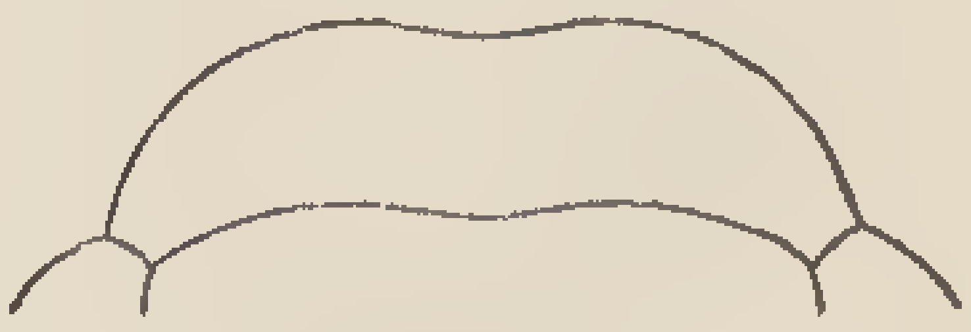
ALIADA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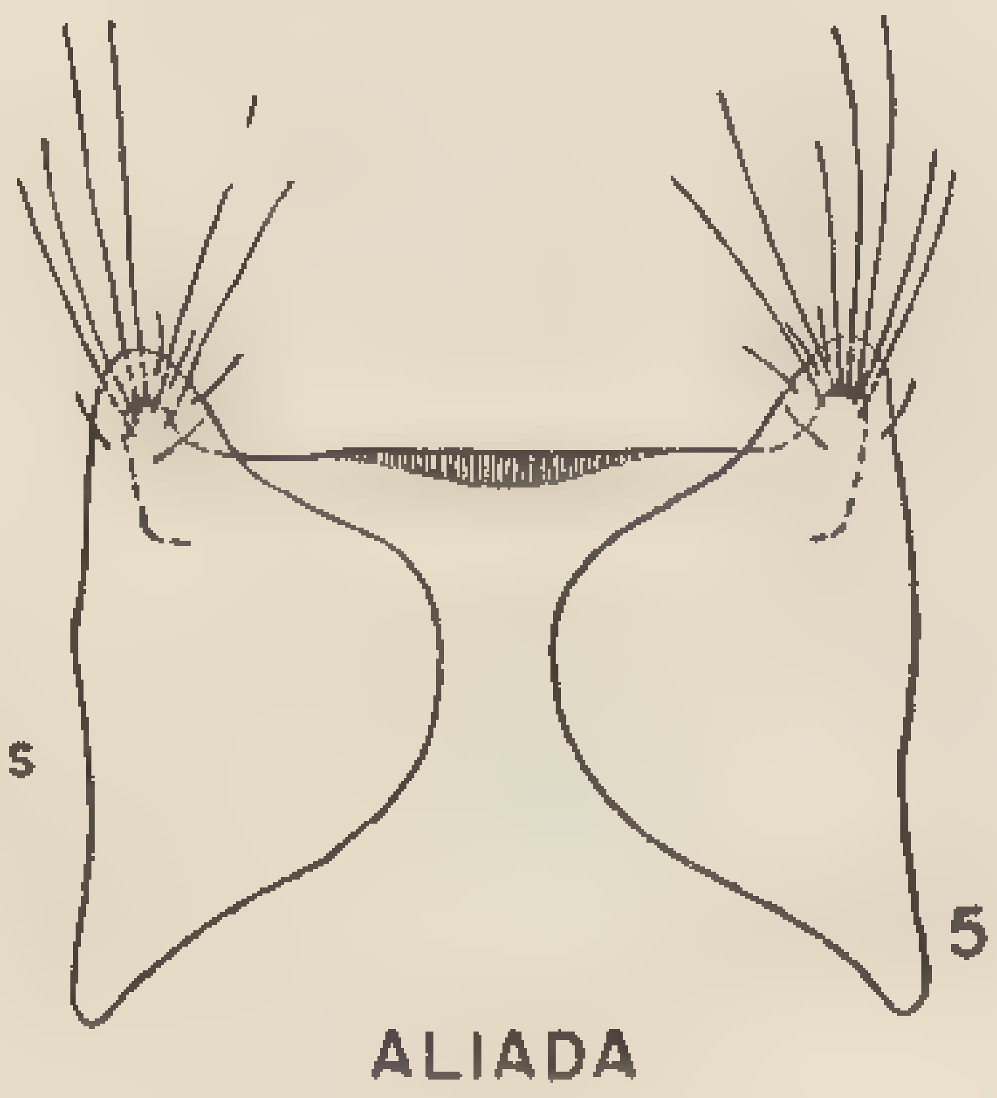
ALIADA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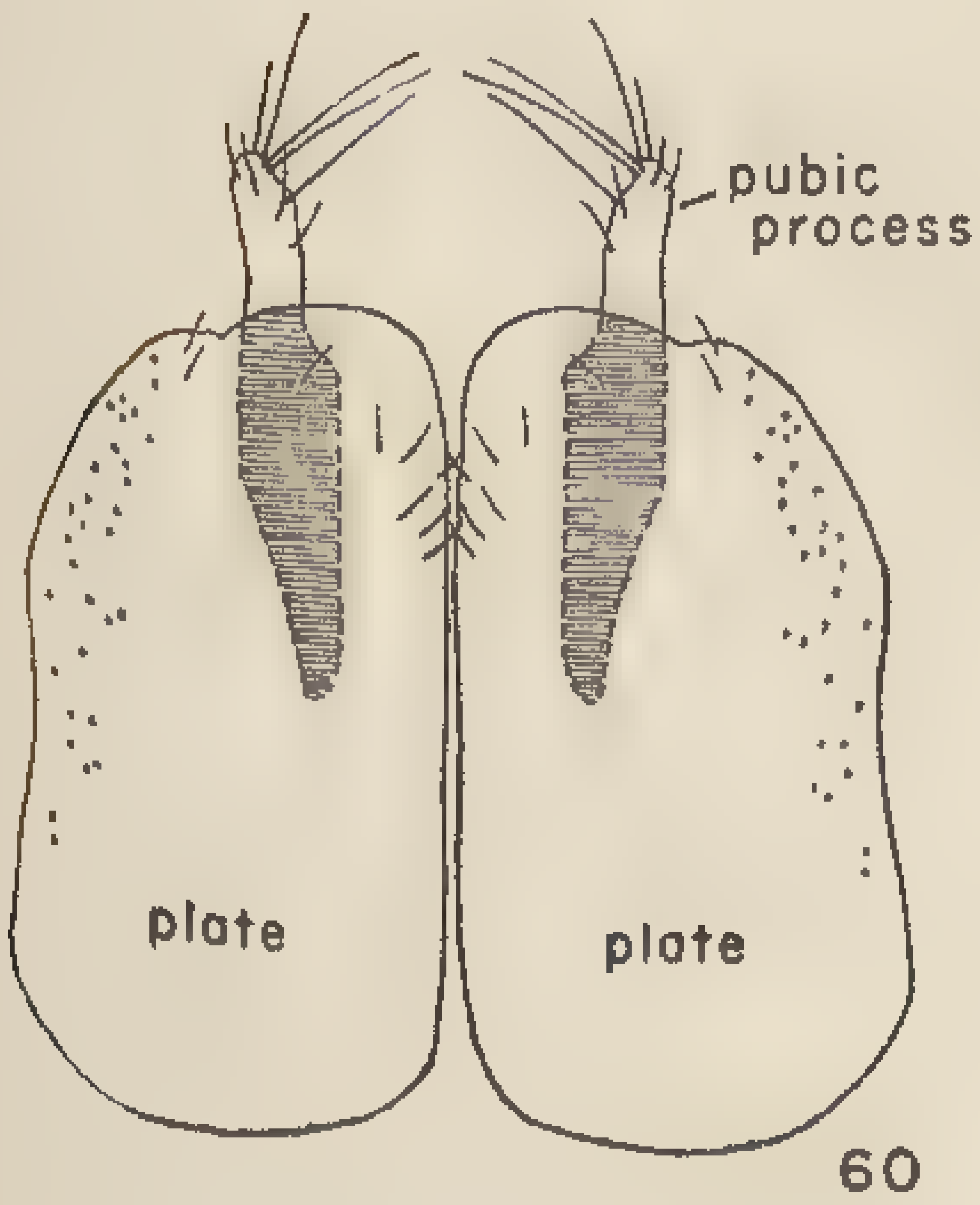
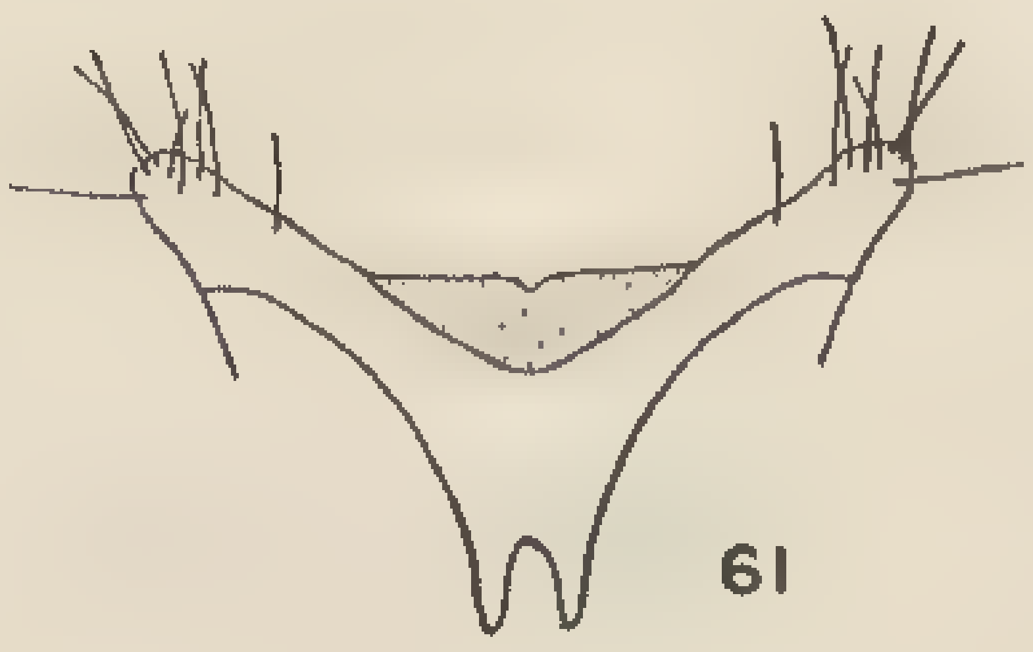
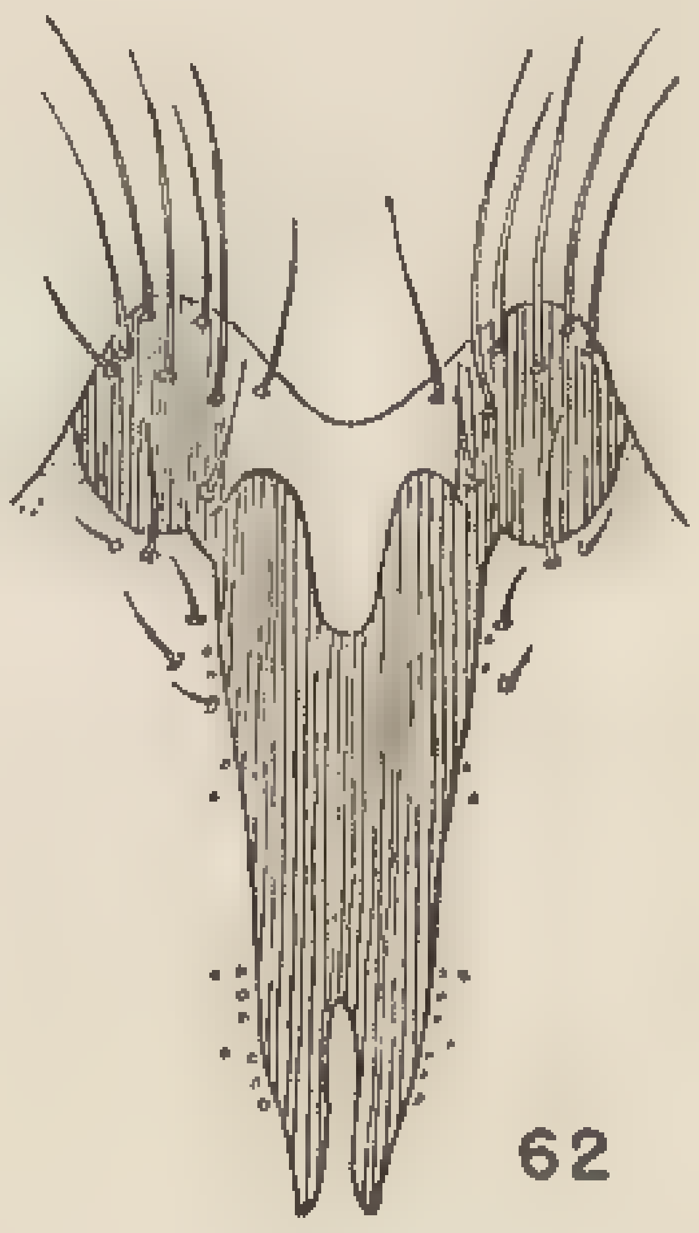
ALIADA


pubic process
plate
plate
60
CANOA


61
HOGARDI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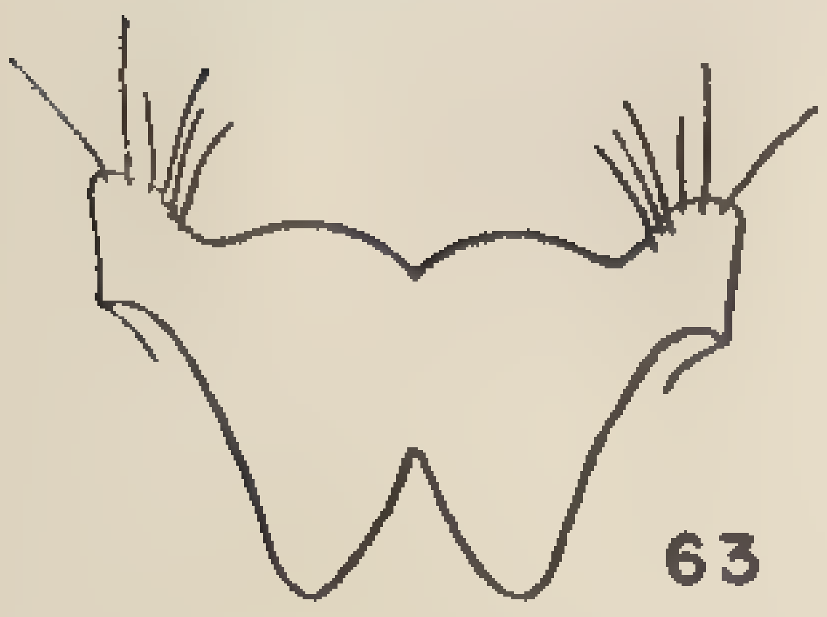
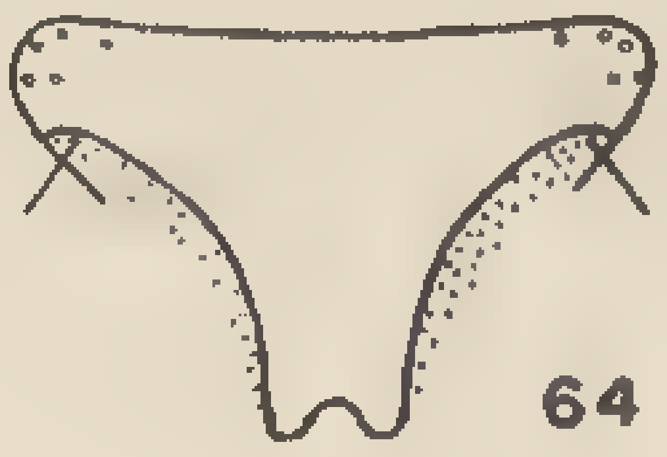
PERMAGNA


63
ROMANA


64
LEPTOSPICA

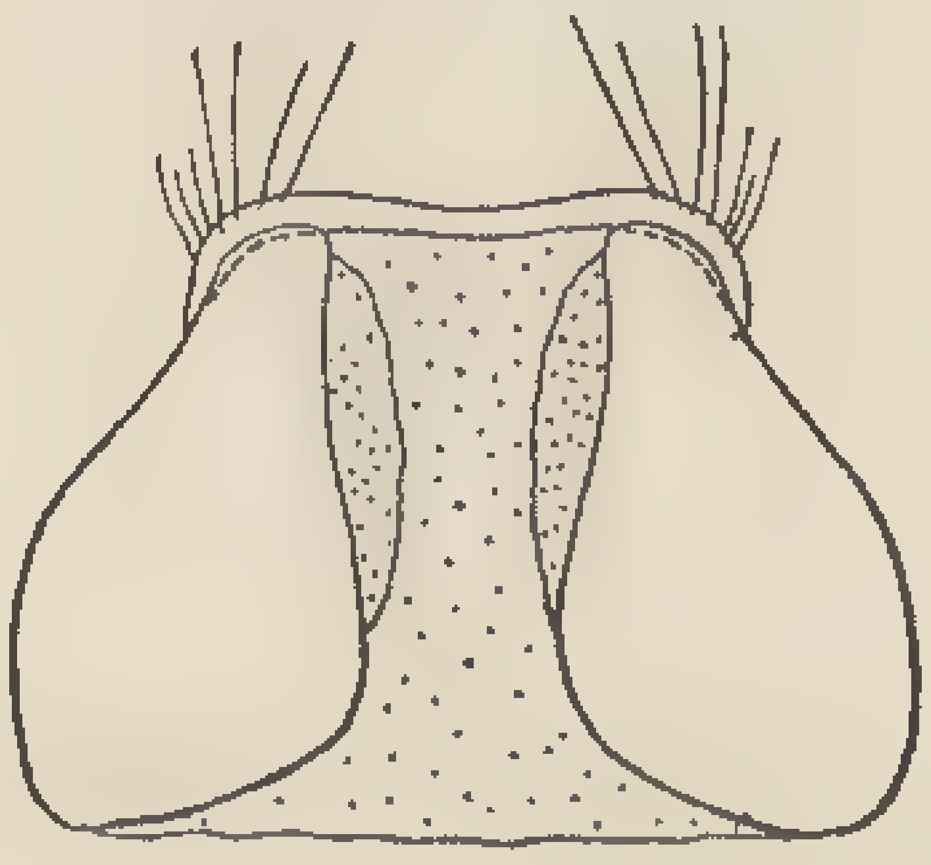
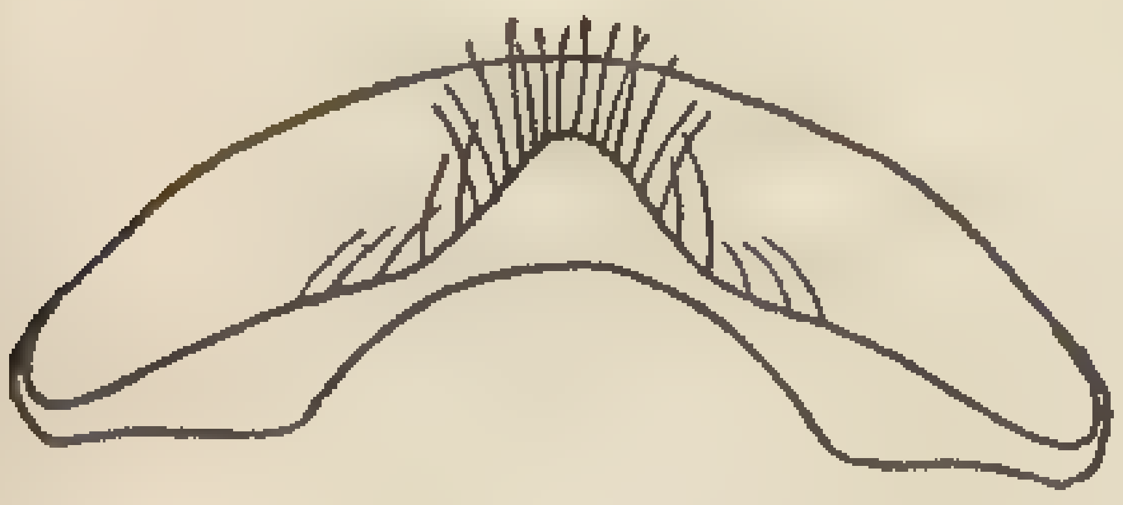

65
PSEUDOCALOARIS

PLATE 6

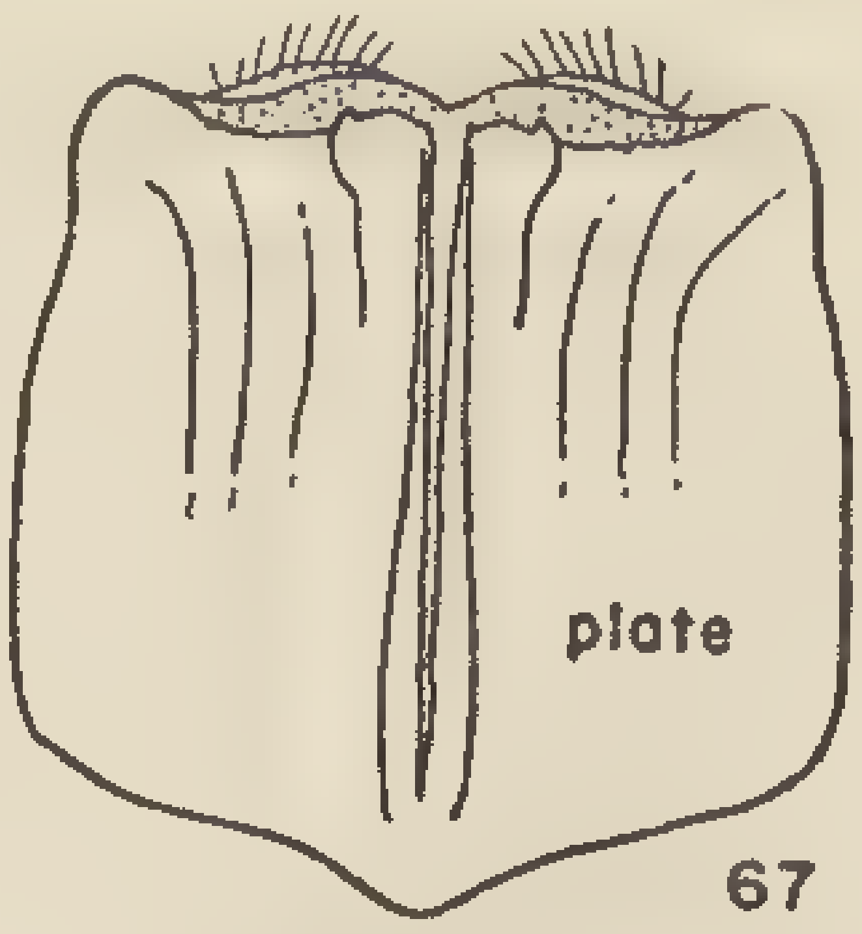
Phyllophaga spp.

Fig. 66. *kenscoffi* Wolcott, apex of female pygidium, ventral.
Fig. 67. *kenscoffi* Wolcott, female genitalia.
Fig. 68. *kenscoffi* Wolcott, female pubic process.
Fig. 69. *latiungula* Wolcott, female pubic process.
Fig. 70. *cartaba* n. sp., female pubic process.
Fig. 71. *minutissima* Wolcott, female genitalia.
Fig. 72. *audanti* Wolcott, female pubic process.
Fig. 73. *recorta* n. sp., female genitalia.
Fig. 74. *mella* n. sp., female genitalia.
Fig. 75. *neglecta* (Blanchard), female genitalia.
Fig. 76. *barrosa* n. sp., female genitalia.
Fig. 77. *mali* Wolcott, female genitalia.



66

KENSCOFFI



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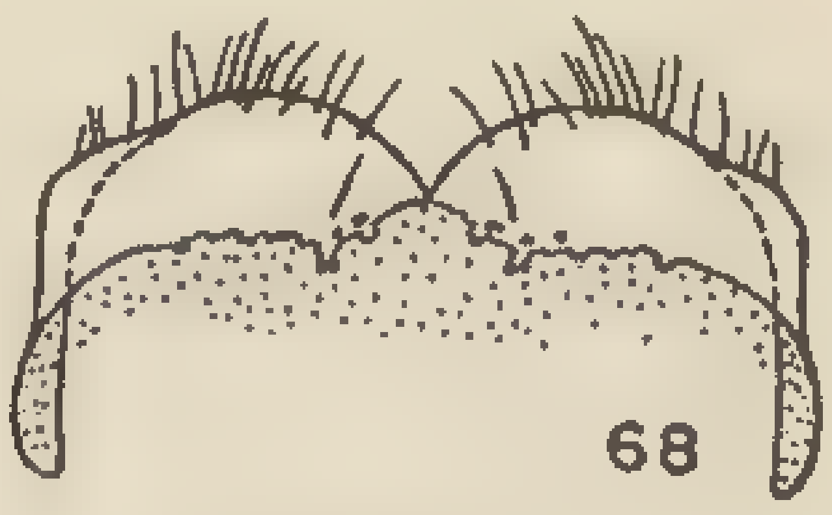

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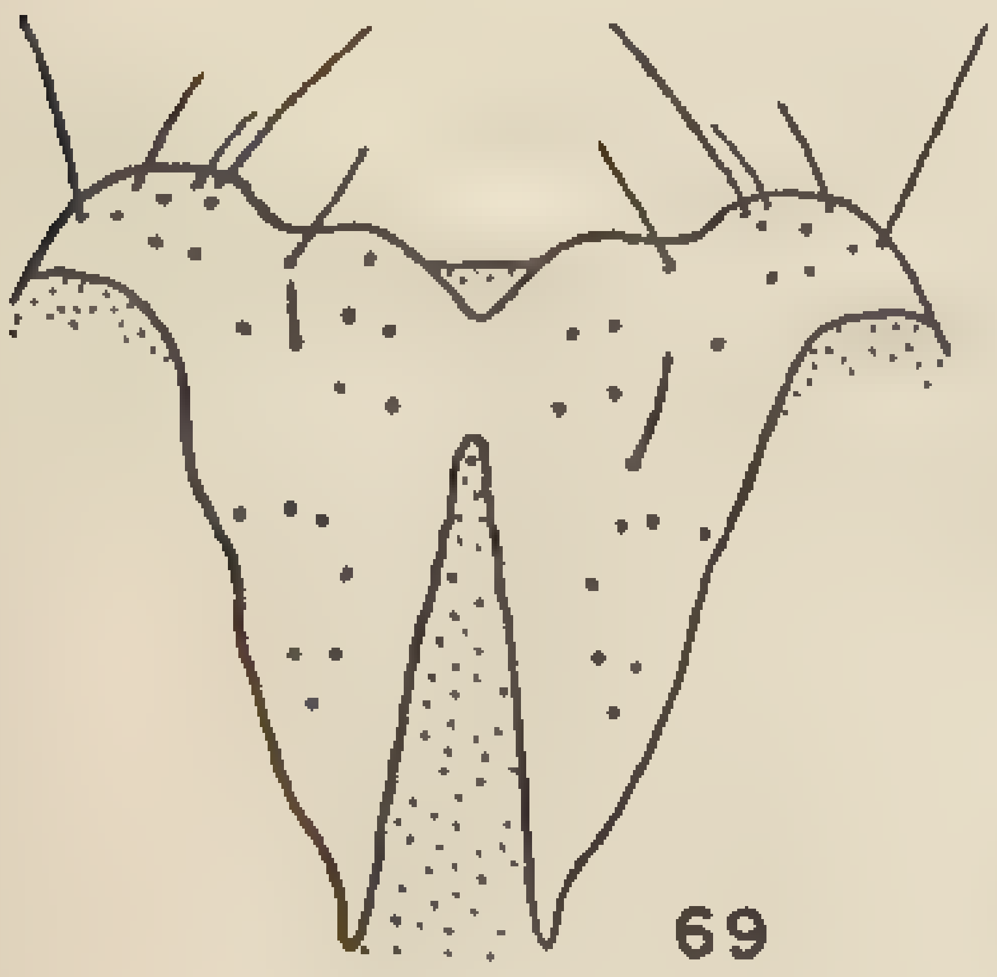

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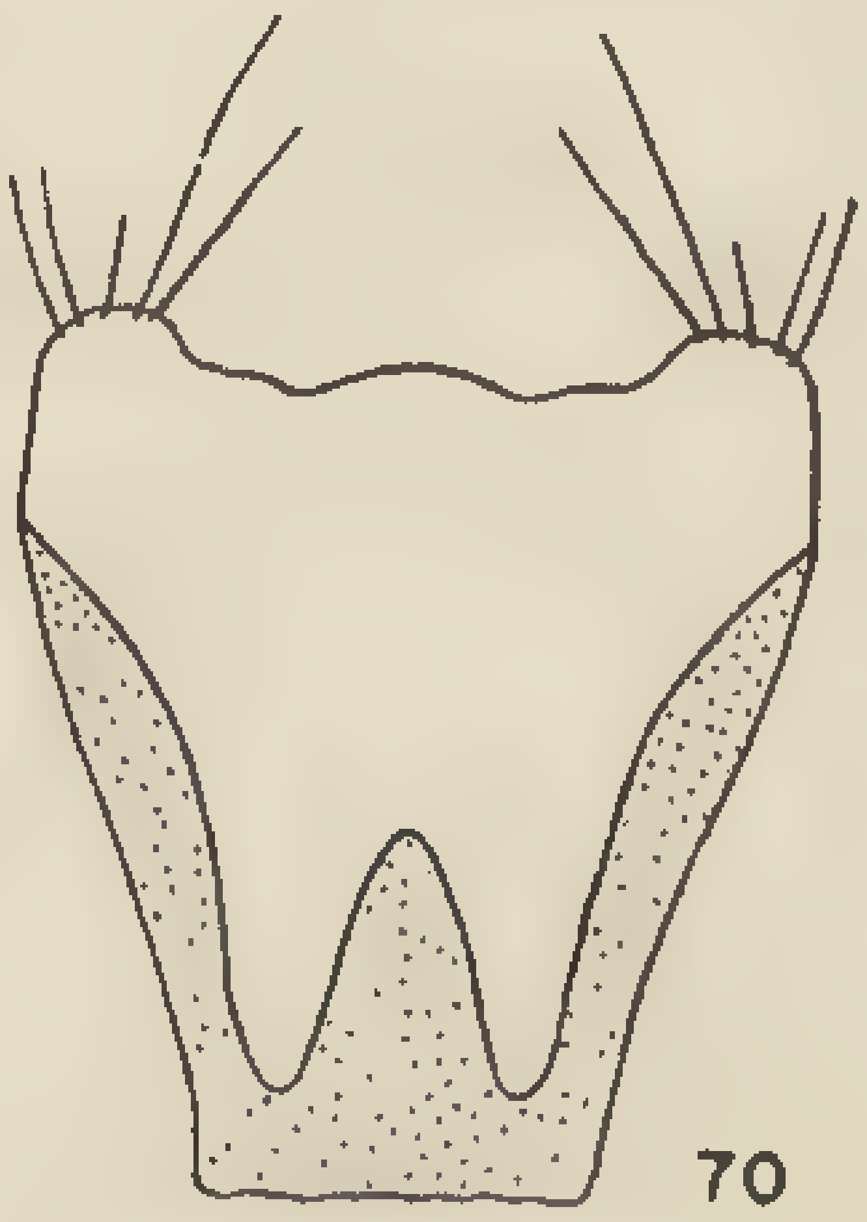

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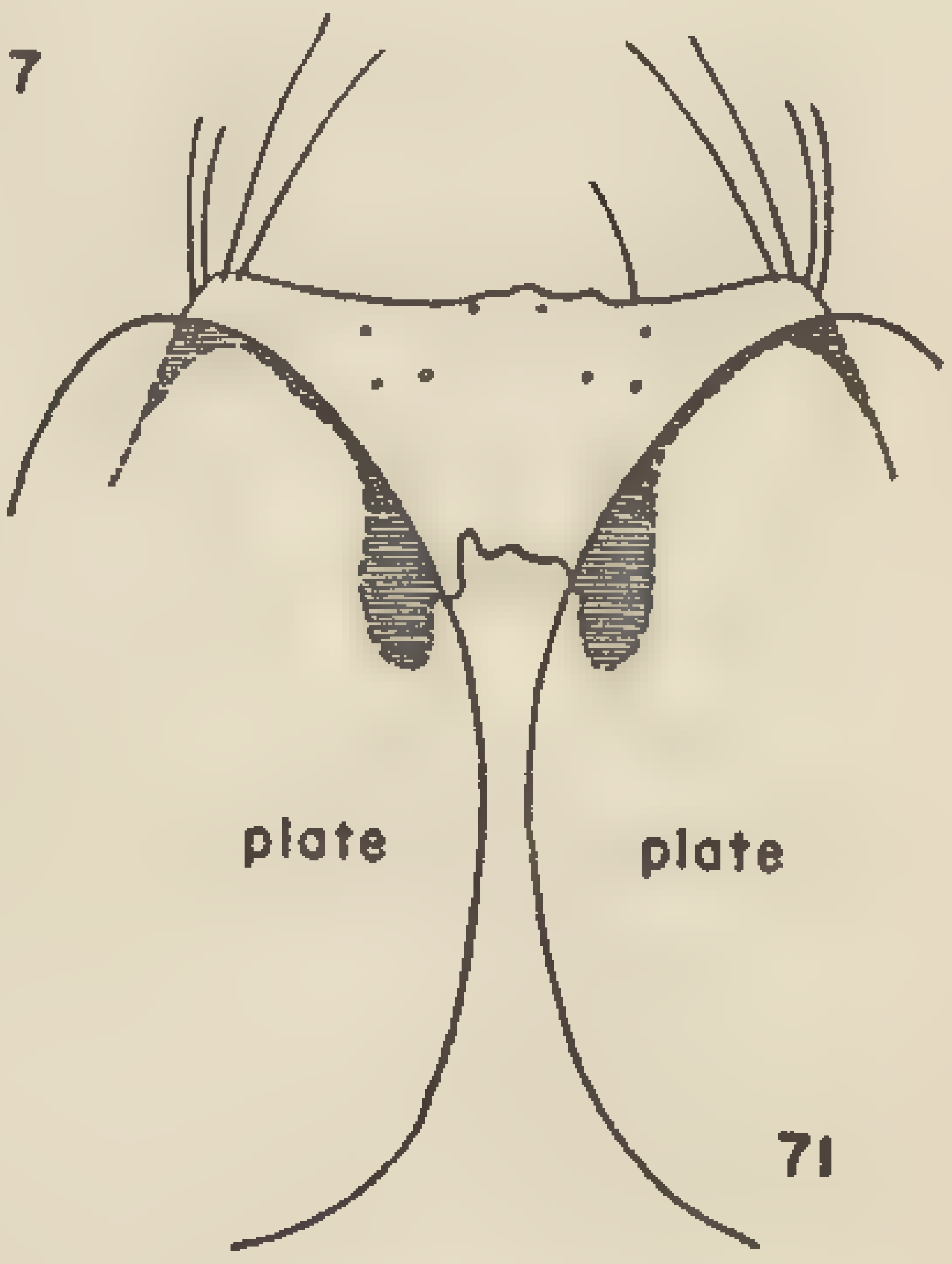
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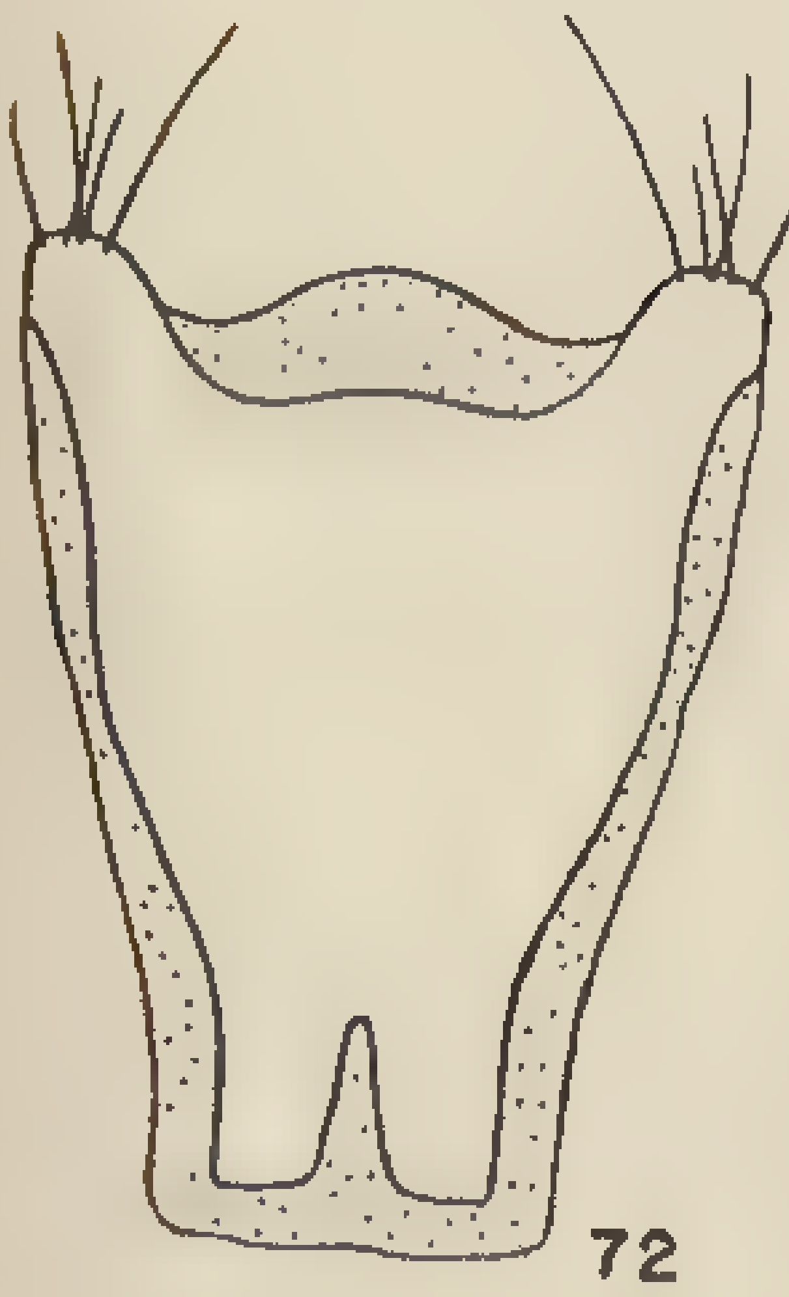

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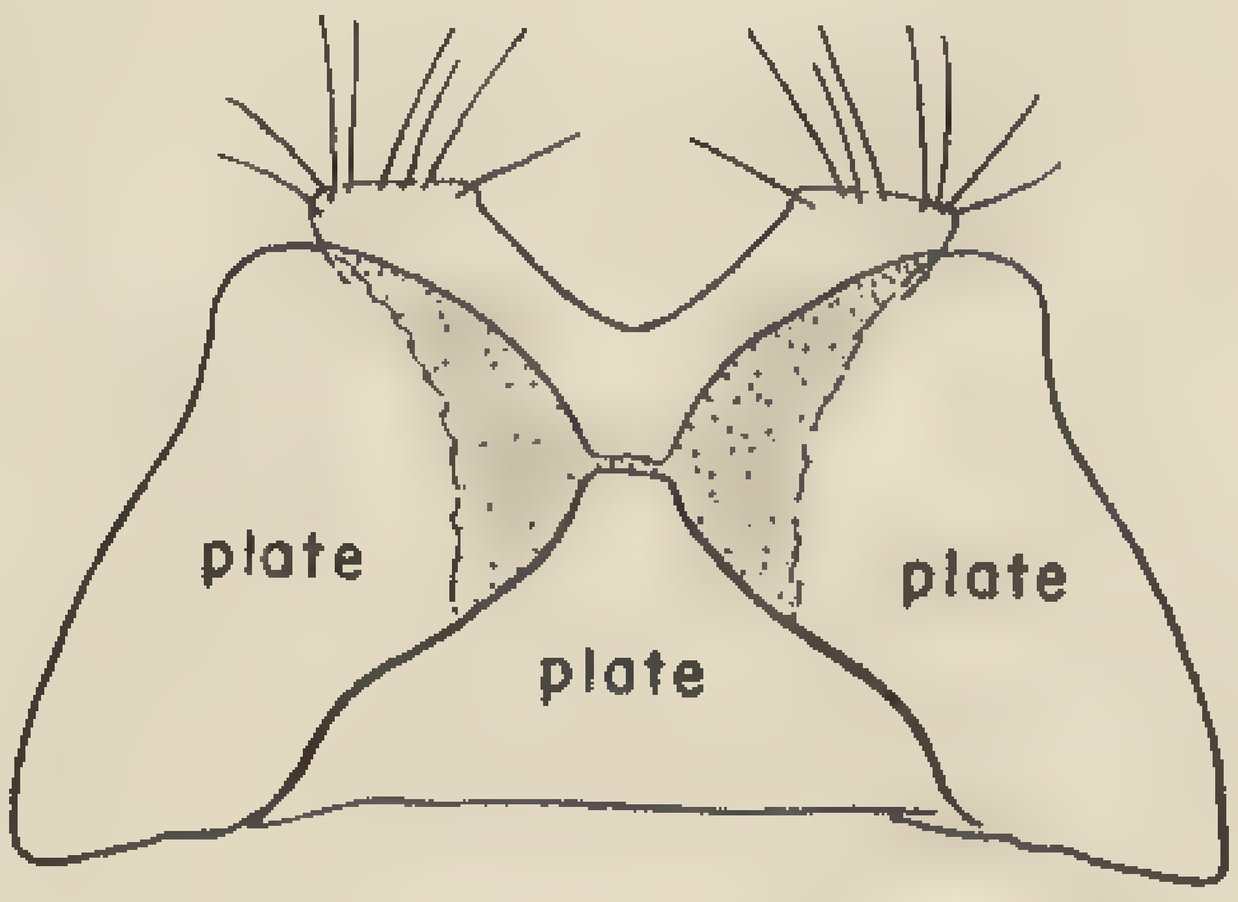
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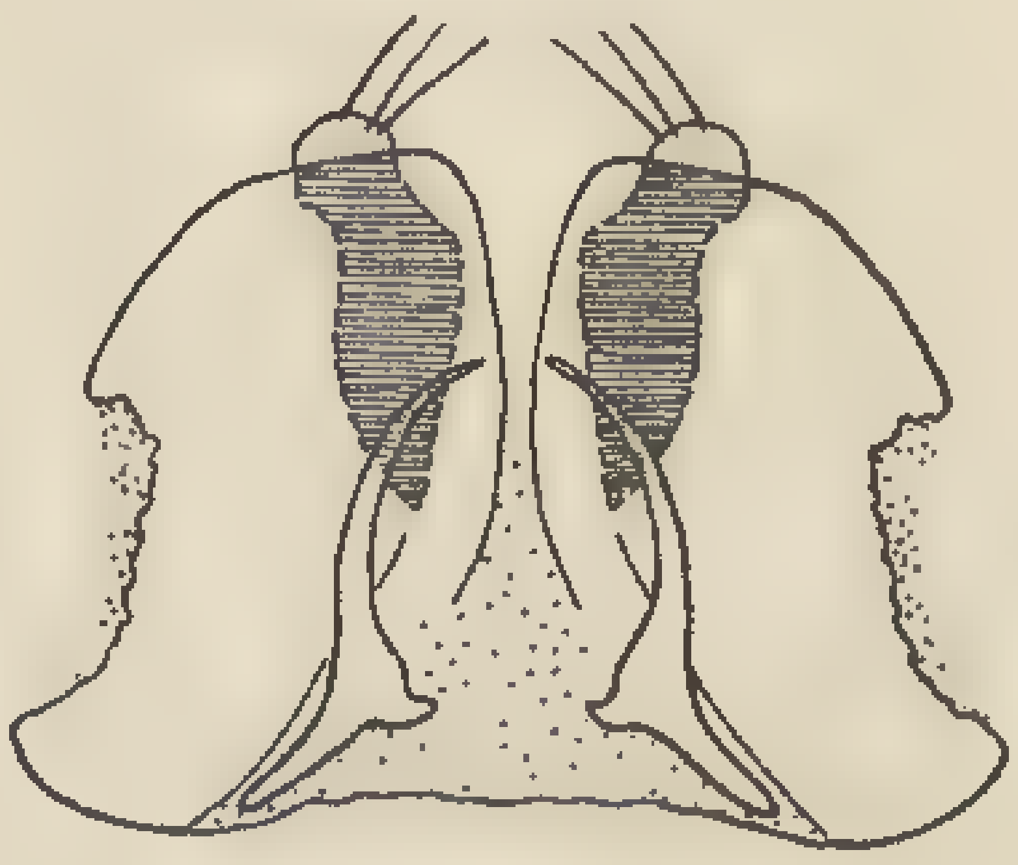

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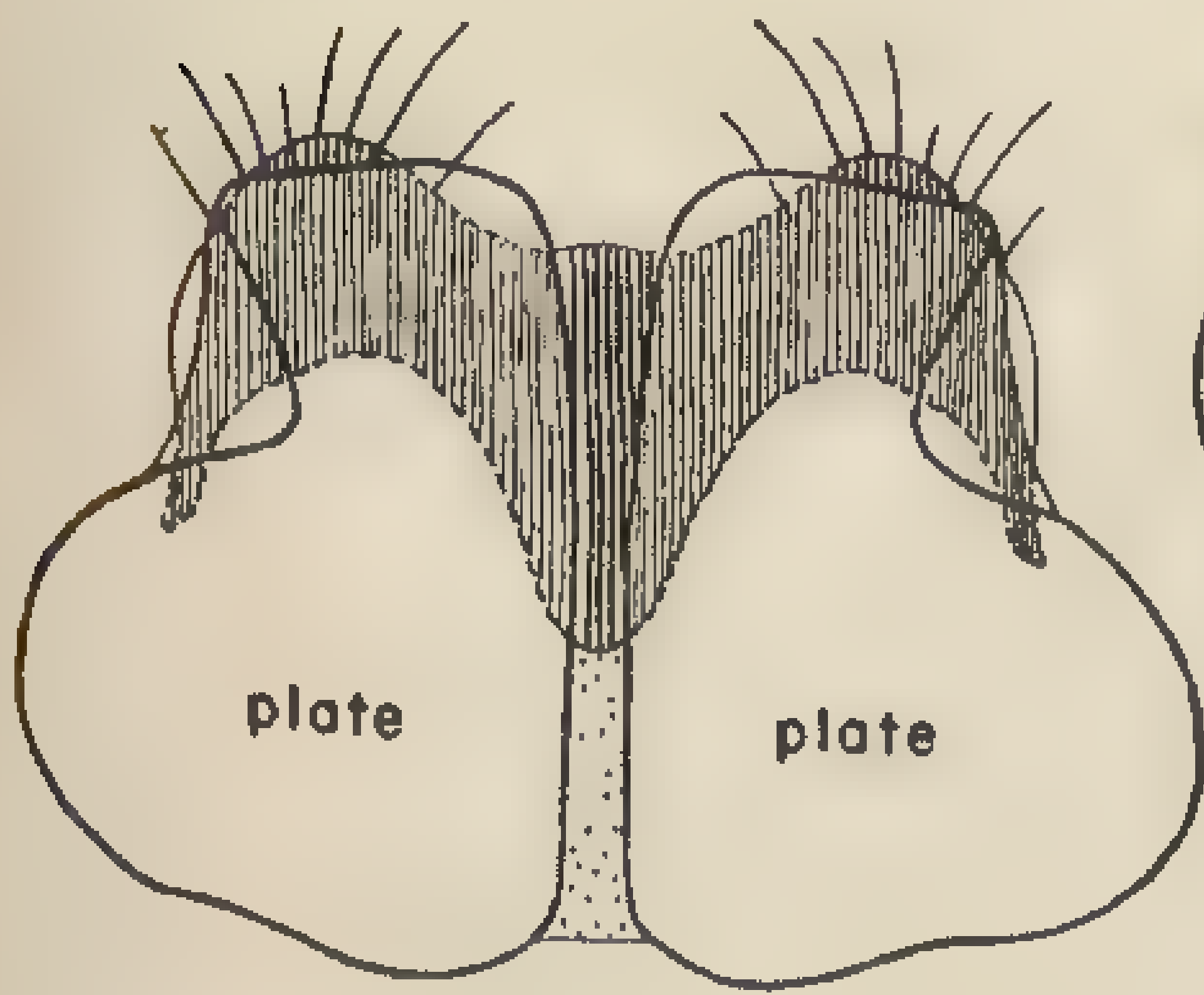
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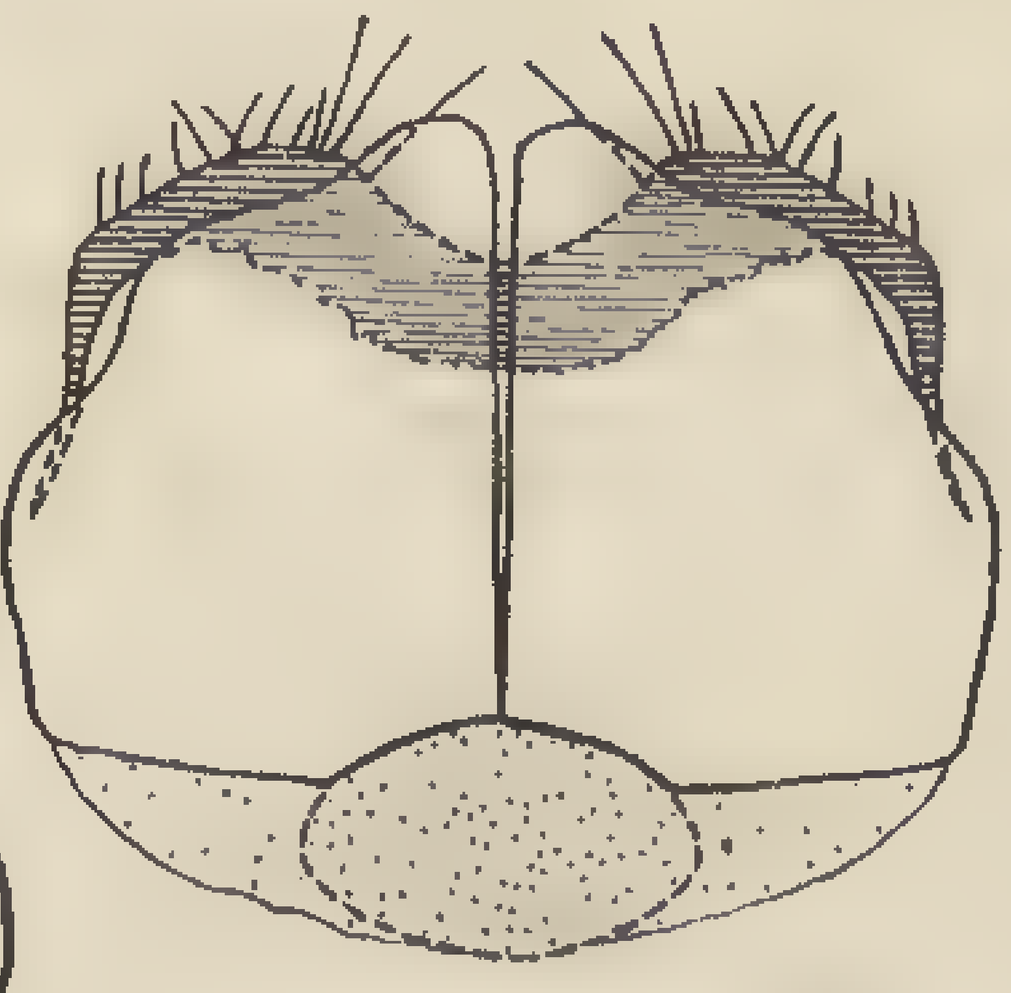

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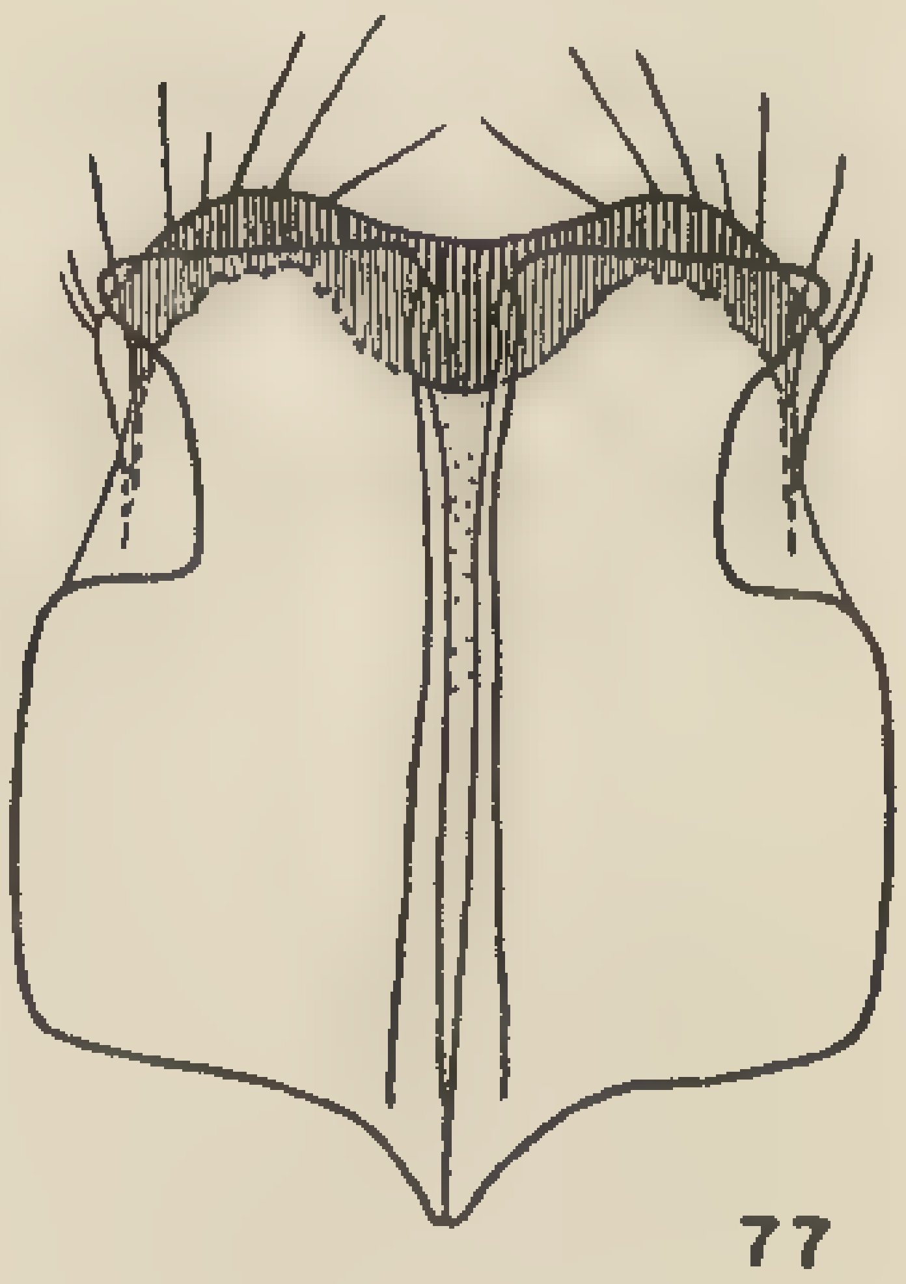

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MALI

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. 106, No. 7

A REVISION OF THE BEETLES OF THE GENUS *CHALCOSICYA* BLAKE (CHRYSOMELIDAE) FROM THE WEST INDIES

By Doris H. Blake

With Three Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM

November 1951

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November 1951

No. 7—*A Revision of the Beetles of the Genus Chalcosicya Blake (Chrysomelidae) from the West Indies*

By Doris H. Blake

In 1930[1] I described the genus *Chalcosicya*, basing it on the new species *C. maestrensis* from the Province of Oriente, Cuba, and associating with it *Heteraspis nana* Suffrian, also from Cuba. In 1938[2] I described three other species, *C. costata, ditrichota* and *rotunda*. Since then Dr. P. J. Darlington has made a large collection of different species of the genus in the highlands of the central portion of the Dominican Republic. His specimens are in the Museum of Comparative Zoölogy (M.C.Z.), Cambridge, Mass. These, together with some others that are in the United States National Museum (U.S.N.M.) collection, form the basis for the present paper. From Darlington's collecting in both Cuba and Hispaniola it is evident that species of this genus are abundant in the mountains of these two islands. One species apiece is also described here from Puerto Rico; Guadeloupe; Eleuthera Island, Bahamas; and Antigua. In addition, *Colaspidea insularis* Blatchley from the Isle of Pines is shown to be an earlier name for *Chalcosicya costata* Blake, and *Nodonota wolcotti* Bryant is recognized as *Chrysomela crotonis* Fabricius, a species of *Chalcosicya*.

Chalcosicya, like *Myochrous* and *Glyptoscelis*, is covered more or less densely with scales or hairs and has the thoracic episternum lobed under the eyes. Unlike *Myochrous* it does not have the margin of the thorax toothed. Unlike *Glyptoscelis* its species are all tiny, rather lightly squamulose or hairy, and more of the shape of *Nodonota*. In fact, Bryant, overlooking entirely the difference in the episternum as well as the presence of scales, described *wolcotti* under that genus. Blatchley described *insularis* under the genus *Colaspidea*. The species of the genus *Colaspidea*, the European as well as the American, are covered by fine, not scale-like, hairs; there is no toothing of the femora; the eyes of the American *Colaspidea* are much smaller; and in all the thorax is contracted at the base, not widest there. There are also antennal differences. The European species are for the most part wingless. One of the West Indian species of *Chalcosicya* is also wingless, but quite different in appearance.

Description of the genus. From 2 to 5 mm. in length (only 2 species 5 mm.), oblong oval or oval, usually very shiny black or deep reddish-brown, often with a bronzy lustre, 2 species very dark green; usually with a coarse white hair from each puncture.

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[1] Blake, Bull. Brooklyn Ent. Soc., Vol. 25, 1930, p. 215.

[2] Blake, Proc. Ent. Soc. Washington, Vol. 40, 1938, pp. 44–46.

Head inserted to the eyes in the prothorax, smoothly rounded over occiput and front to labrum, with only a slight median vertical depression down the front; eyes widely separated, nearly entire, moderately large; surface of head alutaceous and finely and not very densely punctate with a coarse hair or scale from each puncture, these sometimes absent in the middle. Antennae with 1st joint swollen, 2nd elongate equalling in length 3rd, joints 3 to 6 slender and subequal, 7 to 11 much thicker and longer. Prothorax narrowed anteriorly, not contracted at base but widest towards base and usually not quite twice as wide as long, margined; upper surface often alutaceous, usually not densely punctate but more finely so than elytra, with a pale hair or scale from each puncture; thoracic episternum beneath curved upward and covering lower rim of eye and visible behind the eye from above; disc moderately convex and smoothly rounded. Elytra wider than prothorax, convex, with prominent humeri (absent in the one wingless species) and usually with a basal callosity on each side of the scutellum and often in the female a ridge running from the humerus midway down the margin, sometimes another shorter one straight down from the humerus, in a few species prolonged to the apex and forming a lateral fold; sometimes faint costae down the middle; in a few species the apex narrowly prolonged; punctation usually coarser than on prothorax, usually not very dense and often more or less striate; a scale or hair, sometimes erectish, from each puncture. Epipleura disappearing before apex; body underneath always dark and shining beneath the white hairs or scales; the space between the coxae wide, the quadrate space between the anterior coxae usually punctate and with longer hairs; breast punctate; in the majority of species all the femora with a tooth, although in a few species (as in *Chalcosicya maestrensis* and *nana* from which the first generic description was drawn up) no sign of toothing; tibiae not emarginate; claws very deeply toothed at base. Aedeagus showing considerable variation in shape of the tip and in a few closely related species furnishing the only reliable way of distinguishing them.

Key to the Species

1. Wingless. Dominican Republic........................*aptera* n. sp.
   Winged..2
2. Femora without toothing................................3
   Femora toothed..9

3. Elytra narrowly prolonged at apex in female........................4
Elytra simply rounded at apex....................................7
4. Legs pale reddish-brown. Antigua.......................*plana* n. sp.
Legs dark reddish-brown or black..................................5
5. Elytra with a shallow round depression at the end of the humeral sulcus and in female a lateral fold. Cuba.................*maestrensis* Blake
Elytra without a marked depression at the end of the sulcus..........6
6. Prothorax not quite twice as wide as long. Puerto Rico, St. Croix...... *wolcotti* (Bryant)
Prothorax about a third wider than long. Dominican Republic......... *acuminata* n. sp.
7. From 3 to 4 mm. in length; prothorax and elytra very finely and not densely punctate, elytral hairs long and appressed. Dominican Republic......................................*darlingtoni* n. sp.
Less than 3 mm. in length; prothorax and elytra densely or coarsely punctate..8
8. Densely and evenly covered with short pale appressed scales. Cuba..... *nana* (Suffrian)
Not densely or evenly covered by scales, scales on elytra erectish. Oriente Province, Cuba..................................*rotunda* Blake
9. Thorax and elytra glabrous (except for a few hairs only detected under high magnification). Dominican Republic...............*glabra* n. sp.
Thorax and elytra with pale scales more or less conspicuous..........10
10. About 2 mm. in length; dark green, very coarsely and densely punctate. Cuba..*parsonsi* n. sp.
More than 2 mm. in length; deep piceous or black with bronzy or aeneous lustre..11
11. Elytra with two kinds of pubescence, one white and coarse, the other very fine and darker. Cuba...........................*ditrichota* Blake
Elytra without any conspicuous difference in pubescence............12
12. Antennae with joints 8 and 9 pale in contrast to dark terminal joints; elytra with striate punctation and towards apex with intervals semicostate (at least in female). Oriente Prov., Cuba.....*semicostata* n. sp.
Antennae with joints 8 and 9 not conspicuously paler than terminal joints...13
13. More than 4 mm. in length. Guadeloupe...............*grandis* n. sp.
Less than 4 mm. in length.......................................14
14. No sign of ridging running from the humerus down to the margin in female..15
Ridging present to a greater or less degree from the humerus to margin, more apparent in the female.................................18
15. Elytra finely and inconspicuously pubescent.......................16
Elytra either evenly covered with white scales or having scales about the edges..17
16. Small, 2 to 2.5 mm. in length; black. Dominican Republic.*parvula* n. sp.
Larger, 3.5 mm.; shining with a coppery or aeneous lustre. Dominican Republic...*senilis* n. sp.

17. From 2.5 to 3.5 mm. in length; antennae and tibiae reddish-brown. Dominican Republic . . . . *truncata* n. sp.
From 3.5 to 3.9 mm. in length; antennae except basal joints dark, tibiae pale only in apical half. Dominican Republic . . . . *villosa* n. sp.
18. Punctation on elytra very dense, almost contingent; two well defined elytral costae 19
Punctation on elytra not at all contingent; no very well defined elytral costae 20
19. Aedeagus broadly rounded at tip. Eleuthera Is., Bahamas . . . . *eleutherae* n. sp.
Aedeagus sharply pointed. Isle of Pines . . . . *insularis* (Blatchley)
20. A certain scale pattern on elytra 21
Elytra evenly covered by scales 22
21. Unusually broad and convex, the thorax nearly twice as wide as long. Dominican Republic . . . . *convexa* n. sp.
Not unusually broad or convex, the thorax not nearly twice as wide as long. Dominican Republic . . . . *constanzae* n. sp.
22. Aedeagus rounded at tip. Dominican Republic . . . . *teres* n. sp.
Aedeagus more tapering 23
23. Elytral scales appressed (see drawing of aedeagus). Dominican Republic. *fraterna* n. sp.
Elytral scales erectish (see drawing of aedeagus). Dominican Republic . . . *gemina* n. sp.

CHALCOSICYA MAESTRENSIS Blake

(Fig. 7)

Chalcosicya maestrensis Blake, Bull. Brooklyn Ent. Soc., Vol. 25, 1930, p. 216.

About 4 mm. in length; oblong oval, black, shining with a bronzy lustre, labrum and mandibles paler, antennae with joints 1 to 2 and 8 to 9 pale; scales short and inconspicuous; elytra with a lateral fold, more pronounced in the female, and a depression below basal callosity; elytra at apex prolonged.

Head distinctly alutaceous with obsolete fine punctures; scales apparent on the sides, disappearing at middle; a median vertical depression down front. Antennae with joints 1, 2, 8 and 9 pale, remainder brownish; joints 2 to 6 subequal, remainder longer and thicker. Prothorax about a half wider than long, not much narrowed anteriorly, distinctly alutaceous and rather finely and densely punctate, each puncture with a very short inconspicuous scale, longer on the sides. Elytra with prominent humeri; in the female a ridge forming a fold from humerus to apex and another from humerus along the side near the margin, these folds only faintly marked in the male; also a distinct depression below the intrahumeral sulcus; punctation dense, not very coarse in basal half, coarser on sides and with a tendency to being striate, especially in the apical half where the punctation is finer and less dense. Body beneath deep reddish-brown or piceous; breast not densely or coarsely punctate; all femora without toothing. Length 4 to 5 mm.; width 2.3 to 2.6 mm.

Type In U.S.N.M. (Cat. No. 43,114).

Type data. Summit of Pico Turquino, Sierra Maestra, Oriente Prov., Cuba, 4,500–6,000 ft. July 1922, S. C. Bruner and C. H. Ballou; also collected in same locality, June 1936, P. J. Darlington (in M.C.Z.).

Remarks. The lack of femoral toothing is unusual, and in the original description of the genus, based on this species, the statement was made that the femora are not toothed, which is not true of most of the species. The elytral fold combined with the prolongation of the apex characterizes this species.

CHALCOSICYA ACUMINATA n. sp.

(Fig. 24)

From 3 to 4 mm. in length; oval, entirely dark, shining, with a bronzy or green lustre, legs and antennae dark; a few white hair-like scales about edges of upper surface; prothorax and elytra similarly punctate, not very densely or coarsely; prothorax approximately one-third wider than long and much narrower than elytra; elytra somewhat prolonged at apex.

Head and mouthparts entirely dark, finely alutaceous and rather densely and coarsely (for head) punctate, a fine white hair from each puncture; a depression in the middle of the front. Antennae entirely dark, shining with a metallic lustre, joints 2 to 6 slender and subequal, 7 to 11 thicker and longer. Prothorax at base about one-third wider than long, narrowed anteriorly, finely alutaceous about edges, this becoming indistinct and the surface polished within; punctures rather fine and not very dense; a few white hairs about edges. Elytra with prominent humeri and prolonged at apex; punctation not very dense or coarse, with a tendency to being striate, finer at apex; surface highly polished; about the edges and at apex a few white hairs; no traces of elytral costation. Body beneath dark, alutaceous, with the breast densely punctate; legs entirely dark and with metallic lustre; femora not toothed. Length 2.8 to 4.2 mm.; width 1.7 to 2.3 mm.

Types. Holotype male and 15 paratypes in M.C.Z. (Type No. 28,400); 2 paratypes in U.S.N.M. (Cat. No. 59,465).

Type data. Loma Rucilla and mountains north, 5,000–8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Remarks. This species is readily recognized by its entirely dark coloration, untoothed femora, and the narrowly prolonged elytra.

Chalcosicya crotonis (Fab.)

(Fig. 10)

Chrysomela crotonis Fabricius, Ent. Syst. I (1), 1792, p. 327.
Nodonota wolcotti Bryant, Ann. Mag. Nat. Hist., ser. 8, Vol. 13, 1924, p. 302.

About 4 mm. in length; oblong oval, black, shining, with a bronzy, often faintly aeneous lustre, with mouthparts, legs and antennae reddish-brown; prothorax finely and densely punctate, elytra more coarsely and tending to be striately punctate; a very short pale scale from each puncture; femora not toothed; elytra slightly prolonged at the apex in female.

Head alutaceous, finely and not densely punctate; a slight depression in middle of front; a short, closely appressed hair from each puncture. Antennae deep reddish-brown, joints 2 to 6 subequal and slender, 7 to 11 thicker and longer. Prothorax not quite twice as wide as long, narrowed anteriorly, densely but not coarsely punctate; a short scale from each puncture. Elytra with a slightly produced apex in female; humeri not so prominent as in many species and in the female with a strong rib from humerus to margin and often a strong fold from humerus straight down half way to apex, this varying in certain races; surface densely and moderately coarsely punctate, the punctures tending to be in rows; the length of the scales rather variable, in some specimens the scales very indistinct; in the female a considerable variation in ribbing. Body beneath deep piceous, with longer, fine, pale hairs; breast densely and coarsely punctate; legs reddish-brown, femora not toothed. Length 3.7 to 4.5 mm.; width 2.4 to 2.6 mm.

Types. In Zoölogical Museum at Copenhagen; 2 specimens.

Type data. On the specimens, "ex Ins. Amer. Pflug"; in the description, "Habitat in Crotone glanduloso Americae meridionalis. Dr. Pflug".

Other material. Puerto Rico: Guanica, June 20, 1934, C. M. Matos and July 30, 1934, R. G. Oakley; Ponce, on cotton; Ponce, on leaves of *Dioscorea* sp., Aug. 11, 1933, R. G. Oakley; Parguera, on leaves of *Colubrina*, Sept. 4, 1933, A. G. Harley; Faro de Cabo Rojo, April 20, 1929, Stuart Danforth; Areceibo, May 21, 1923, G. N. Wolcott; Mamayes, Nov. 11, 1922; Luquillo, Dec. 10, 1923, Muertos Island, on *Casuarina*, Nov. 3–4, 1929, J. E. Mabray, H. K. Plank; Caja de Muertos, March 22, 23, 1935, R. Bonilla and V. Biagga (Stuart Danforth); Mona Is., April 6, 1944, G. N. Wolcott. Virgin Islands: St. Croix, P. G. Russell, H. A. Beatty; Christiansted, H. A. Beatty; Altoona Estate, near East End Road.

Remarks. While examining type specimens in the Fabrician collection in the Zoölogical Museum at Copenhagen, I found two specimens labelled "*C.* (*Chrysomela*) *crotonis* ex Ins. Amer. Pflug". In his description Fabricius gave the locality of this species simply as "America meridionalis". Pflug, the collector, is known to have spent some years in St. Croix and died there, leaving his collection to Fabricius. These two well preserved specimens are a species of *Chalcosicya* that occurs in St. Croix as well as Puerto Rico. Fabricius, as I noted also in the case of several other species, has referred some eumolpids to *Chrysomela.*

Bryant described *wolcotti* under the genus *Nodonota,* but since *Nodonota* has no prosternal projection behind the eyes, this beetle, possessing these postocular blinders, cannot be rightly placed in that genus. Moreover it has very short but quite distinct scales from each puncture, which is not true of species of *Nodonota.* I was unable to find the type of *wolcotti* in the British Museum but specimens identified by Bryant as *wolcotti* from Areceibo and Mameyes have been examined.

Dissection shows that there are at least four closely related races occurring on Puerto Rico, St. Croix and neighboring small islands. Whether these are distinct species is not clear. The aedeagi show quite distinct differences but the beetles are for the most part otherwise indistinguishable, although there is a little variation in the degree in which the females are ribbed about the humerus. At this time, with an insufficient number of specimens, I hesitate to name these races as species, and for the present, at least, will give them only varietal names, calling attention to the differences in the shape of the aedeagi. The types from St. Croix have a strong costa from the humerus to the margin and a fairly strong one straight down the elytra, and may be the variety named here as *Chalcosicya crotonis,* var. *acuta.* Which race Bryant described is rather doubtful. There are three races along the southern coast and only one, so far, in our rather limited material from the northern coast. Two specimens from Guanica which is near Yauco (not of Wolcott's collecting) are of the variety named here as *angularis,* having aedeagi with the tip angular. Since this variety does not have marked ribbing about the humerus, it is probably not the one that Bryant described.

CHALCOSICYA CROTONIS var. SEPTENTRIONALIS n. var.

(Fig. 10A, B)

Females with a strong development of the fold from humerus to margin and an equally strong fold from humerus straight down the elytron to the middle or beyond. Aedeagus with the median orifice situated at some distance from the tip, the tip broad and gradually coming to a rounded point.

Types. Holotype and 1 paratype in U.S.N.M. (Cat. No. 59,720).

Type data. Luquilla, Puerto Rico, Dec. 10, 1933, A. S. Mills. Paratype from Mameyes, Nov. 11, 1922. I believe 2 females from Areceibo, P. R., collected May 21, 1933 by G. N. Wolcott, are of the same race. All are from the north coast. The specimens illustrated are from Mameyes (fig. 10A) and from Luquilla (fig. 10B).

CHALCOSICYA CROTONIS var. ANGULARIS n. var.

(Fig. 10D, E, F)

Females with one rib from humerus, this extending to the margin, not compressed into a sharp fold, only vestiges of rib running straight down. Aedeagus with median orifice situated not so far from the tip, the tip broad and distinctly angulate near end.

Types. Holotype and 8 paratypes in U.S.N.M. (Cat. No. 59,721).

Type data. Ponce, Puerto Rico, collected on leaves of *Dioscorea* sp. Aug. 11, 1933, by R. G. Oakley. Other localities: Guanica, July 30, 1934, R. G. Oakley, C. M. Matos; Faro de Cabo Rojo, April 20, 1939, Stuart Danforth. These specimens all come from the southwest coast. The specimens illustrated are from Guanica (fig. 10D); from Faro de Cabo Rojo (fig. 10E); from Ponce (fig. 10F).

CHALCOSICYA CROTONIS var. PARGUERENSIS n. var.

(Fig. 10C)

Females with a strongly compressed fold from humerus to margin and a second from humerus straight down the elytron, in one specimen to apical curve. Aedeagus broad and rounded at the tip.

Types. Holotype and 3 paratypes in U.S.N.M. (Cat. No. 59,722).

Type data. Parguera, P. R., Sept. 4, 1933, A. G. Harley, on leaves and flowers of *Colubrina* sp. The specimen illustrated in figure 10C is from Parguera.

CHALCOSICYA CROTONIS var. ACUTA n. var.

(Fig. 10G, H, I)

Females with 2 moderately strong folds from the humerus. Aedeagus tapering narrowly to a rounded tip.

Types. Holotype and 4 paratypes in U.S.N.M. (Cat. No. 59,723).

Type data. Muertos Island, off coast of Puerto Rico, on *Casuarina*, H. K. Plank and J. E. Mabray, Nov. 3 to 4, 1949.

Other material. "ex. Ins. Amer. Pflug", "habitat in *Crotone glanduloso*"(?); Ponce P. R., on flowers of cotton; Caja de Muertos, March 22, 23, 1935, V. Biaggi and R. Bonilla (Stuart Danforth); St. Croix, Virgin Islands, H. A. Beatty and P. G. Russell (U.S.N.M.).

This variety occurs along the southern coast of Puerto Rico and seems to be the same in St. Croix. Specimens illustrated are from Ponce (fig. 10G), from Muertos Island (fig. 10H), from St. Croix (fig. 10I).

CHALCOSICYA PLANA n. sp.

(Fig. 22)

Between 3 and 4 mm. in length; oblong oval, black, shining with a bronzy or at times greenish lustre, mouthparts, legs and antennae reddish-brown; a very short scale from each of the dense and, on elytra, striate punctures; femora not toothed.

Head very smooth and alutaceous, not very shiny, with a few fine scattered punctures over occiput and front, on lower front a little coarser and denser and with a very short scale from each puncture; a slight median frontal depression; mouthparts dark reddish-brown. Antennae pale reddish-brown, joints 2 to 6 subequal, 7 to 11 a bit longer and thicker. Prothorax approximately twice as wide as long, a little narrowed anteriorly; faintly alutaceous and densely and not coarsely punctate with a very short pale scale from each puncture. Elytra with prominent humeri and in female a slight ridge from the humerus down to lateral margin and sometimes two faint costae on the upper side of elytra, these not apparent in the male; in the female the elytra at apex somewhat prolonged; punctation very dense, not very coarse, distinctly striate, and from each puncture a very short pale scale. Body beneath with longer pale scales; breast with moderately coarse punctures arranged in rows; abdomen piceous with finer pale hairs. Legs reddish-brown with short pale scales; femora not toothed. Length 3 to 4 mm.; width 1.9 to 2.3 mm.

Types. Holotype male and 13 paratypes in U.S.N.M. (Cat. No. 59,467); 2 paratypes in M.C.Z. (Type No. 28,402).

Type data. Antigua, West Indies, collected in June by Stoner.

Remarks. The characteristics of this species which is rather closely related to *C. crotonis* (Fab.) are the very short fine scales from each puncture and the dense, striate elytral punctation. The elytra are without marked basal callosities, being rather flat. It is smaller, with paler legs and with more densely punctate elytra than *C. crotonis*.

CHALCOSICYA NANA (Suffrian)

(Fig. 2)

Heteraspis nana Suffrian, Archiv f. Naturg., Vol. 32, 1866, p. 337.

About 2.5 mm. in length; oval, shining with a bronzy lustre beneath the dense, pale, closely appressed scales; legs and antennae reddish-brown with the apex of the seventh and sometimes the following joints deeper brown; femora not toothed.

Head finely punctate and nearly covered by the regularly placed, closely appressed white scales; a median vertical depression down front. Antennae reddish-brown, sometimes the apex of the 7th and following joints dark; joints 2 to 6 subequal in length, 7 to 11 longer and thicker. Prothorax not twice as wide as long, finely punctate, with dense, closely appressed pale scales. Elytra with prominent humeri, very densely and rather coarsely punctate, the punctures becoming finer towards apex; from each puncture a closely appressed scale, sometimes pale brown and forming an irregular pattern. Body beneath with pale scales, finer on abdomen; breast and first abdominal joint densely punctate. Legs reddish-brown; the femora not toothed. Length 2.3 to 2.9 mm.; width 1.4 to 1.6 mm.

Type. Location not determined.

Type locality. Cuba.

Other material. All from Cuba: Cayamas, June 5, E. A. Schwarz; Baraguá, L. C. Scaramuzza; San Rafael, San José, on citrus, May 24, 1945, Alemon (all U.S.N.M.); Soledad, Cienfuegos, May and June 1939, C. T. Parsons, (in M.C.Z.).

Remarks. Suffrian's specific name is appropriate since this is one of the tiniest species. It is also unusual in being so densely covered by scales as to appear grayish.

CHALCOSICYA ROTUNDA Blake

(Fig. 13)

Chalcosicya rotunda Blake, Proc. Ent. Soc. Washington, Vol. 40, 1938, p. 44.

About 2.5 mm. in length; oval, black, shining with a bronzy, sometimes bluish lustre; tibiae, tarsi and sometimes basal half of femora reddish-brown; rather coarsely punctate with suberect white hairs; femora not toothed.

Head with deep dense punctures in lines over occiput; a shallow depression in middle of front; white scales short, not concealing the surface of the head. Antennae deep reddish-brown, the two basal joints often paler, distal joints thicker and darker. Prothorax not quite twice as wide as long, alutaceous, with scattered and rather coarse punctures tending to be in lines anteriorly; in some specimens a slight depression on either side made by a circle of punctures. Elytra convex, with prominent humeri and a depression below on the side; punctures coarse, rather dense and tending to be striate; elytral hairs suberect and apparently in a certain pattern (scales on most specimens badly rubbed), leaving the basal callosities and middle of elytra bare with the scales on the sides and at apex. Body beneath shining; breast finely punctate; abdomen piceous with lighter hairs; legs with femora sometimes pale at base, tibiae and tarsi pale reddish-brown; femora not toothed. Length 2.2 to 2.7 mm.; width 1.5 to 1.7 mm.

Type. In U.S.N.M. (Cat. No. 52,307).

Type data. Pico Turquino, Sierra Maestra, Oriente Prov., Cuba, July 1922, S. C. Bruner and C. H. Ballou; also collected on Pico Joaquin to Turquino, 5,300 to 6,300 ft., June 1948, by J. Acuña (in U.S.N.M.).

Remarks. This small roundish beetle differs from most of the others in size and in having untoothed femora. The rather coarse sparse punctures on the elytra are set with more or less erect white scales.

CHALCOSICYA INSULARIS (Blatchley)

(Fig. 4)

Colaspidea insularis Blatchley, Canadian Ent., Vol. 54, 1922, p. 32.
Chalcosicya costata Blake, Proc. Ent. Soc. Washington, Vol. 40, 1938, p. 45.

Between 2.5 and 3 mm. in length; oblong oval, shining, deep reddish-brown with antennae and legs a little paler, apices of outer joints of antennae tending to be dark; surface evenly covered with short, white, closely appressed scales; prothorax not so densely or coarsely punctate as elytra; elytra in female with 2 or 3 interrupted costae, these not so apparent in the male.

Head evenly and not coarsely punctate with a short white scale from each puncture; a faint median frontal depression. Antennae pale reddish-brown with the distal joints in one specimen darkened at apex; 2nd joint long, joints 3 to 6 short and slender, 7 to 11 longer and thicker. Prothorax a half wider than long, overshadowing head; surface finely and moderately densely punctate with a short, white scale from each puncture. Elytra not quite three times as long as prothorax, convex, with prominent humeri and a slight depression below basal callosities; punctation very close and rather coarse; two more or less interrupted costae and faint traces of a third from the humerus in the female, these costae being bare, impunctate, slightly elevated. Body beneath reddish-brown, punctate, with a scale from each puncture, these scales rather densely covering surface; femora finely toothed. Length 2.6 to 3 mm.; width 1.6 to 1.7 mm.

Types. In Blatchley collection, Purdue University, Lafayette, Indiana; 1 cotype in U.S.N.M. (Cat. No. 59,724); 1 specimen in Fall collection (M.C.Z.).

Type data. Isle of Pines, West Indies.

Remarks. Upon examination of Blatchley's types, I am able to establish the identity of this species with *C. costata* which I described in 1938. The shining, bare, semivittate lines on the elytra together with the dense elytral punctation characterize this species. Blatchley reported it as being sent in for identification by the citrus growers as on citrus fruit trees.

CHALCOSICYA ELEUTHERAE n. sp.

(Fig. 3)

About 3.5 mm. in length; oval, shining black often with a bronzy lustre beneath the long white appressed hair-like scales, antennae and legs deep reddish-brown; head and prothorax finely and moderately densely punctate, elytra more distinctly and moderately densely punctate; elytra with faint traces of two costae.

Head finely punctate over occiput, becoming more densely and coarsely punctate between the eyes; a faint frontal depression; entirely dark with fine white scales. Antennae reddish, 2nd joint longer than 3rd which is shorter than 4th, joints 7 to 11 thicker and longer than preceding. Prothorax not quite twice as broad as long at base, narrowed anteriorly, finely and moderately densely punctate with a long appressed white scale from each puncture. Elytra a little wider than prothorax, smoothly convex, with prominent humeri, surface moderately densely and coarsely punctate, in the female often with two narrow bare lines on each elytron that produce a faintly costate appearance; scales moderately long and appressed. Body beneath piceous black with a little shorter pale pubescence; breast densely punctate; legs deep reddish-brown; all femora toothed. Length 3.2 to 3.7 mm.; width 2.2 to 2.3 mm.

Types. Holotype and 5 paratypes in U.S.N.M. (Cat. No. 59,466). 1 paratype in M.C.Z. (Type No. 28,401).

Type data. Eleuthera Island, Bahamas, July 9 to 15, H. F. Wickham.

Other material. Two specimens labelled simply "Bahamas"; 2 from Harbor Island, Bahamas, July 8, H. F. Wickham, (U.S.N.M.).

Remarks. This species, although not markedly different from the others, is quite distinct. It is similar to *Chalcosicya darlingtoni* from the Dominican Republic but has more coarsely punctate elytra.

CHALCOSICYA GRANDIS n. sp.

(Fig. 12)

About 5 mm. in length; oblong oval, moderately shiny, deep reddish-brown with paler antennae, legs and undersurface and with white scales; prothorax finely and densely punctate, elytra a little more coarsely and not so densely punctate, the punctures tending to be denser in a depressed area below basal callosity.

Head alutaceous and rather densely punctate, the short white scales in the single specimen rubbed away but probably a single scale from each puncture; a median frontal depression. Antennae with 2nd joint longer than 3rd, 4th and 5th longer than 3rd or 6th, 7 to 11 longer and thicker, 7th longest. Prothorax one half wider than long; surface finely alutaceous and finely and densely punctate with white scales about edges (? rubbed off on top). Elytra almost three times as long as prothorax, with prominent humeri and in male (female unknown) a faint ridging from the humerus down along elytral margin; also a shallow depression below basal callosity in which the punctures and scales from each puncture form a little depressed circle; punctation tending to be striate and not very dense or coarse, but coarser than on prothorax. Body beneath reddish-brown with fairly dense appressed white scales; breast finely punctate; femora all finely toothed. Length 4.8 mm.; width 2.6 mm.

Type. Holotype male in U.S.N.M. (Cat. No. 59,461).

Type data. Guadeloupe, West Indies, 3,000 ft., July 30, collected by August Busck.

Remarks. This is one of the largest species of the genus and one of the palest, being deep reddish-brown. Unfortunately the single specimen is rubbed so that the scale pattern is not clear.

CHALCOSICYA SEMICOSTATA n. sp.

(Fig. 14)

About 4.5 mm. in length; oblong oval, lustrous black except the mandibles and antennae, the latter with the basal and 8th and 9th joints pale; prothorax finely punctate; elytra rather coarsely, densely and towards the apex tending to be striately punctate, with the interspaces more or less ridged; four strong costae on each elytron of the female; a short white scale from each puncture; femora minutely toothed.

Head not very coarsely or densely punctate, with a few short white hairlike scales and a shallow median depression on the front. Antennae with joints 1 to 2 and 8 to 9 pale, remainder deep reddish-brown. Prothorax not quite twice as broad as long, not greatly narrowed anteriorly; surface lustrous, finely and not very densely punctate; the white scales very short. Elytra with prominent humeri and four distinct costae (in female), the marginal one beginning on the humerus and running down along the margin even to the apex; the interspaces becoming ridged towards the apex and on the sides; the white scales very short and not apparent in basal half. Body beneath entirely dark; breast not very coarsely or densely punctate. Femora very minutely toothed, in fact the hind femora not distinctly toothed. Length 4.4 mm.; width 2.6 mm.

Type. Holotype female in M.C.Z. (Type No. 28,395).

Type data. Loma del Gato, Cobre Range, Oriente Province, Cuba, about 3,000 ft., July 3 to 7, 1936, P. J. Darlington.

Remarks. The large size, striate punctation of the elytra, and in the female the ridges at the apex of the elytra, distinguish this species.

CHALCOSICYA APTERA n. sp.

(Fig. 15)

About 4 mm. in length; oval, black, shining with a bronzy lustre, antennae and legs deep reddish-brown; covered with long erectish pale hairs with some finer darker ones interspersed on elytra; prothorax finely and densely, elytra more coarsely and more densely punctate; wingless, without humeral prominences.

Head shining deep reddish-brown under the fine pale erectish hairs, rather densely and moderately coarsely punctate; a depression in the middle of the front. Antennae reddish-brown; joints 2 to 6 subequal and slender, remainder longer and thicker. Prothorax not quite twice as broad as long, not greatly narrowed anteriorly; surface finely and densely punctate and covered by long, erectish pale hairs. Elytra scarcely wider than prothorax at base, without humeral prominences (wingless), gradually widened to behind the middle, with a broadly rounded apex, moderately convex; surface densely and moderately coarsely punctate and covered by long erectish pale hairs with some darker finer ones interspersed. Body below shining beneath the light pubescence; breast densely and coarsely punctate; front and middle femora minutely toothed but hind femora very indistinctly toothed; legs with long fine hairs. Length 4 mm.; width 2.7 mm.

Type. Holotype female in U.S.N.M. (Cat. No. 59,462).

Type data. Azua, Dominican Republic, March 21, 1913, Paul G. Russell.

Remarks. Mr. Russell states that this single female specimen was collected in a desert-like area near Azua on a slightly elevated plateau not very close to the mountains. It is the only wingless species without humeral prominences so far known in the group and has the longest vestiture.

CHALCOSICYA PARSONSI n. sp.

(Fig. 11)

Approximately 2 mm. in length; oblong oval, lustrous dark-green with yellow-brown mouthparts, antennae, and legs, and piceous abdomen; very coarsely and densely punctate above with a white scale probably from each puncture (the single specimen with only remnants of the easily rubbed off white scales); all femora minutely toothed.

Head shining dark-green with pale yellow-brown mouthparts, not densely punctate but the punctures tending to radiate from the middle of the front; no frontal depression; a coarse white scale from each puncture. Antennae pale yellow-brown, joints 2 to 6 subequal in length, distal joints longer and thicker. Prothorax not quite twice as wide as long at base, narrowed a little anteriorly, shining and very coarsely and densely punctate with a coarse white scale from each puncture. Elytra about three times as long as prothorax with well developed humeri and a slight transverse depression below; shining dark-green with dense coarse punctures tending to be striate from below the basal callosities to apex; most of the white scales rubbed off but probably originally a scale from each puncture, these scales suberect. Body beneath shining dark-green except the piceous abdomen and yellow-brown legs; the abdomen with a fine light pubescence, the legs, prosternum and breast with somewhat coarser white hairs but not so coarse as on the upper surface; breast moderately coarsely and densely punctate; all femora toothed. Length 2 mm.; width 1 mm.

Type. Holotype female in M.C.Z. (Type No. 28, 405).

Type data. Mina Carlota, Trinidad Mts., Cuba, July 1937, C. T. Parsons.

Remarks. This species is remarkable for its dark-green coloration in a group for the most part black. It is unusually small and with unusually coarse punctation.

CHALCOSICYA DITRICHOTA Blake

(Fig. 23)

Chalcosicya ditrichota Blake, Proc. Ent. Soc. Washington, Vol. 40, 1938, p. 46.

About 3 mm. in length; oblong oval, black, shining with a coppery, aeneous, or even bluish lustre; the pale coarse, hair-like scales not dense and interspersed with a finer, darker pubescence; prothorax more finely and less densely punctate than elytra; antennae bicolored.

Head very shiny with coarse, not very dense punctures, not concealed by the white scales; a slight median depression; mouthparts paler. Antennae with joints 1 to 2 or sometimes all basal joints, and joints 7 to 9 or sometimes only 8 and 9, pale, the remainder dark; joints 2 to 6 subequal and slender, distal joints thicker and longer. Prothorax not quite twice as wide as long with moderately dense and not very coarse punctures, white and finer darker scales intermixed. Elytra coarsely and densely punctate, the coarser white scales intermixed with the more erect darker hairs forming a pattern on elytra, although these scales are readily rubbed off and not present anteriorly in all specimens. Body beneath dark with coarse punctures on breast; legs deep piceous; all femora very minutely toothed. Length 2.2 to 3.4 mm.; width 1.4 to 2 mm.

Type. In M.C.Z. (Type No. 23,154); 2 paratypes in U.S.N.M. (Cat. No. 52,759).

Type data. Buenos Aires, Trinidad Mts., Cuba, 2,500 to 3,500 ft., May 8 to 14, 1936, P. J. Darlington; also collected at same locality by C. T. Parsons in June 1939 (in M.C.Z.).

Other material. Cuba: San Blas and vicinity, Trinidad Mts., 1,000 to 3,000 ft.; Pico Turquino, 5,000 to 6,000 ft. (in M.C.Z.).

Remarks. This species is distinguished by its bicolored antennae and bicolored pubescence.

CHALCOSICYA CONSTANZAE n. sp.

(Fig. 20)

About 3 mm. in length; oval, black, shining with a bronzy lustre, mouthparts, antennae, tibiae and tarsi reddish-brown, femora tending to be darker; thorax finely and densely punctate, elytra a bit more coarsely and not quite so densely punctate, except on the sides below the humeri; punctation tending to be striate; the white scales erectish and forming a pattern on both thorax and elytra, with bare spaces such as on the basal callosities; in the female especially, faint traces of two impunctate lines down the elytra.

Head finely alutaceous and rather coarsely and densely punctate, the white scales densest at sides, the shallow median vertical depression nearly bare. Antennae usually pale, sometimes with the apices of distal joints darker, joints 2 to 6 subequal, 7 to 11 longer and thicker. Prothorax not twice as wide at base as long, narrowed anteriorly, densely punctate especially in middle and on sides, the scales forming a pattern. Elytra with prominent humeri and a depression on the sides below in which the punctures are very dense; in the female, traces of two costae in the form of impunctate lines and also a strong ridge running down from the humerus midway on the margin in both sexes; punctures tending to be striate, not much coarser than on prothorax; the white scales erectish and forming a pattern with the basal callosities bare, the scales densest on the sides and at apex. Body beneath dark with finer white pubescence than on the upper surface; breast densely punctate; legs reddish-brown with the femora tending to be darker at apex; all femora minutely toothed. Length 2.6 to 3.3 mm.; width 1.7 to 2 mm.

Types. Holotype male and 2 paratypes in M.C.Z. (Type No. 28,406); 1 paratype in U.S.N.M. (Cat. No. 59,469).

Type data. Constanza, Dominican Republic, 3,000 to 4,000 ft., August 1938, P. J. Darlington.

Other material. Two specimens from San José de las Matas, 1,000 to 2,000 ft., Dominican Republic, June 1938, P. J. Darlington (M.C.Z.).

Remarks. The oval shape and distinctive elytral pattern of rather coarse erectish scales mark this species. The aedeagus too is unusually truncate at the tip.

CHALCOSICYA DARLINGTONI n. sp.

(Fig. 1)

Between 3 and 4 mm. in length; oval, shining with a bronzy lustre, legs and antennae reddish-brown; covered rather densely with long, pale, closely appressed hairs, arranged in a faintly vittate pattern on the elytra in female specimens, with patches of whiter, coarser scales especially marked towards the apex; both prothorax and elytra unusually finely and not densely punctate.

Head with long pale hairs nearly concealing the fine punctures beneath, punctures becoming coarser in lower front; the usual median vertical depression down front. Antennae reddish-brown, basal joints slender and subequal, distal longer and thicker. Prothorax not quite twice as wide at base as long; very finely and not densely punctate and nearly covered by the long pale appressed hairs, the hairs forming a sort of swirl on the sides. Elytra with prominent humeri, finely alutaceous and not densely punctate, the punctures being unusually fine, although coarser on the sides and nearly concealed by the long pale pubescence; the pubescence consisting of finer, slightly brownish hairs with coarser white scales in patches or spots especially towards the apex and tending to be vittate owing to the bare, impunctate lines in the female. Body beneath dark with fine pubescence; breast more coarsely and densely punctate than upper surface. Legs reddish-brown, femora exceedingly finely toothed. Length 3.2 to 4 mm.; width 2 to 2.5 mm.

Types. Holotype male and 1 paratype in M.C.Z. (Type No. 28,397).

Type data. Constanza, 3,000 to 4,000 ft., Dominican Republic, Aug. 1938, P. J. Darlington.

Remarks. This species is notable because of the very finely punctate elytra. As in *Chalcosicya ditrichota* Blake there are two different kinds of scales on the elytra, only not so markedly different, and the heavier white scales form irregular patches especially towards the apex, with some vittation in the female.

CHALCOSICYA CONVEXA n. sp.

(Fig. 8)

Between 3 and 4 mm. in length; dark reddish-brown to piceous, shining with a bronzy lustre, mouthparts, antennae, tibiae and tarsi deep reddish-brown; rather densely covered by long, pale, hair-like scales; prothorax finely and moderately densely punctate, elytra convex, more coarsely but not more densely punctate; femora finely toothed.

Head bronzy with deep reddish-brown mouthparts; a depression in the middle of the front; rather densely but not coarsely punctate with a long, pale, closely appressed hair from each scale forming a pattern on the front. Antennae pale reddish-brown; joints 2 to 6 slender and subequal, joints 7 to 11 longer and thicker. Prothorax almost twice as wide as long, not much narrowed anteriorly, finely and moderately densely punctate, the punctures on the sides denser; a long pale hair from each puncture, these hairs arranged in a sort of pattern on each side. Elytra convex, with prominent humeri and a basal callosity on each side of the scutellum with a depression below; a faint trace of ridging in a swelling near the margin below the humerus, also two faint traces of elytral costae in the bare impunctate lines down the elytra; punctation confused and coarser than on prothorax; a long pale hair from each puncture. Body beneath deep reddish-brown with long hairs from the fine punctures; breast densely and finely punctate; femora finely toothed. Length 3 to 3.9 mm.; width 2.2 to 2.5 mm.

Types. Holotype female and 1 paratype female in M.C.Z. (Type No. 28,396).

Type data. San José de las Matas, Dominican Republic, 1,000 to 2,000 ft., June 1938, P. J. Darlington.

Other material. 1 specimen from Foothills of Cordillera Central, south of Santiago, Dominican Republic, June 1938, P. J. Darlington (M.C.Z.).

Remarks. This species is unusually broad with a well rounded convexity of the elytra coming to a height part way down the sutural line. Unfortunately there is no male.

CHALCOSICYA VILLOSA n. sp.

(Fig. 9)

About 3.5 mm. in length; oblong oval, black, often shining with a bronzy lustre, basal joints of antennae, apical half of tibiae, and tarsi reddish-brown; head and prothorax more or less alutaceous and finely punctate; elytra moderately densely and coarsely punctate; upper surface covered with white erectish hair-like scales, easily rubbed off.

Head alutaceous and finely punctate, with a short, fine, pale scale from each puncture; a median furrow down head ending in a depression in the middle of the front. Antennae with basal joint edged with black; joints 2 to 4 pale, remainder dark, joints 7 to 11 thicker and longer. Prothorax not quite twice as broad as long, faintly alutaceous and finely punctate with a fine erectish hair from each puncture. Elytra with prominent humeri and basal callosities and a slight transverse depression below; no sign of ridging from the humerus in the female; punctation fairly dense and moderately coarse and not distinctly striate but confused; a fine erectish hair from each puncture. Body beneath black with fine, pale, long pubescence; breast finely punctate;

femora entirely dark, often with aeneous lustre, tibiae dark at base, paler towards apex, the tarsi except claw pale. All femora toothed. Length 3.5 to 3.9 mm.; width 2 mm.

Types. Holotype female and 3 paratypes in M.C.Z. (Type No. 28,398); 1 female in U.S.N.M. (Cat. No. 59,463).

Type data. Valle Nuevo, S.E. of Constanza, Dominican Republic, about 7,000 ft., Aug. 1938, P. J. Darlington.

Remarks. Unfortunately no male is in the collection but this species is different from *Chalcosicya senilis* in having an alutaceous and finely punctate prothorax and being covered with fine erectish hairs, besides being more elongate with a proportionately shorter prothorax. It is very much like *Chalcosicya teres* but larger and with a little finer and denser elytral punctation. It is more elongate than *Chalcosicya fraterna,* in which the elytral hairs or scales are appressed and not erect.

CHALCOSICYA SENILIS n. sp.

(Fig. 5)

About 3.5 mm. in length, oval, lustrous black, shining with a coppery, bluish, or aeneous light, legs usually entirely reddish, antennae with the basal joints reddish; prothorax rather densely and strongly punctate, elytra a little more coarsely and likewise densely punctate; fine white scales on edges of prothorax and elytra.

Head alutaceous and unusually densely and coarsely punctate; the fine white hairs short and more conspicuous on the edges; a vertical depression down the middle of the front. Antennae with joints 2 to 6 subequal, pale beneath, distal joints dark, thicker and longer. Prothorax less than twice as wide as long, narrowed anteriorly, not at all alutaceous, very shiny, densely and strongly punctate, sometimes with a short median bare line; fine appressed white scales about edges becoming shorter and disappearing in the middle. Elytra over twice as long as prothorax and almost as broad as long in females, with prominent humeri, no sign of ridging below humerus; strongly and densely and not at all striately punctate, the punctures becoming finer towards the apex; fine white appressed scales about the edges but becoming shorter and disappearing on top. Body beneath dark with slightly longer but inconspicuous white scales; breast coarsely and densely punctate; legs in three specimens entirely reddish-brown, in the fourth with the apex of femora tinged with dark-green metallic lustre; all femora indistinctly toothed. Length 3.4 to 3.6 mm.; width 2.4 mm.

Types. Holotype male and 2 paratypes in M.C.Z. (Type No. 28,399); 1 paratype in U.S.N.M. (Cat. No. 59,464).

Type data. Loma Vieja, south of Constanza, about 6,000 ft., Dominican Republic, Aug. 1938, P. J. Darlington.

Other material. One specimen (with dark knees) from Loma Rucilla and mountains north, 5,000 to 8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Remarks. This polished, nearly glabrous species somewhat resembles *Chalcosicya acuminata* but does not have the elytra prolonged as in that, but instead has them rounded at the apex.

CHALCOSICYA GLABRA n. sp.

(Fig. 6)

About 3 mm. in length; oval, dark-green except for the reddish-brown mouthparts and basal joints of antennae, very shiny, almost without pubescence on upper surface except for a few inconspicuous hairs about the eyes and on margin of prothorax; undersurface very lacking in pubescence too; prothorax finely, elytra a little more coarsely punctate with a tendency to being striate; elytra not much wider than prothorax; all femora toothed.

Head polished green with a few fine scattered punctures becoming denser and coarser in lower front, and a short median vertical depression on front; mouthparts reddish-brown; some fine inconspicuous hairs about eyes. Antennae with the four basal joints reddish, remainder dark, distal joints longer and thicker. Prothorax not quite twice as wide as long, very shining, finely and moderately densely punctate, a few fine hairs along margin only detected under high magnification. Elytra not much wider than prothorax and about three times as long, with prominent humeri, no trace of ribbing in the female, the punctation a little coarser than on prothorax, but not dense, and tending to be striate. Body beneath dark; prosternum and breast with a few fine hairs, abdomen glabrous; breast densely and coarsely punctate; legs dark, with a greenish lustre; all femora toothed. Length 2.8 to 3 mm.; width 1.8 to 1.9 mm.

Type. Holotype male and 1 paratype in M.C.Z. (Type No. 28,403).

Type data. Foothills of Cordillera Central, South of Santiago, Dominican Republic, June 1938, P. J. Darlington.

Other material. One specimen from Constanza and Jarabacoa, 2,000 to 4,000 ft., Aug. 1938, P. J. Darlington (M.C.Z.).

Remarks. This is the most nearly glabrous of the species of *Chalcosicya* so far treated, but even in this species there are to be detected under high magnification faint traces of fine hairs on the head and prothorax. It is one of the broadly oval species with the elytra not much wider than the thorax.

CHALCOSICYA TERES n. sp.

(Fig. 16)

About 3 mm. in length, oblong oval, black, shining with a bronzy or greenish lustre, basal joints of antennae and apical half of tibiae and tarsi reddish-brown; head and prothorax alutaceous and finely punctate; elytra deeply but not very coarsely punctate, evenly covered with white hair-like scales that on the sides and at the apex of the elytra at least are suberect; all femora toothed.

Head entirely dark except for a deep brownish labrum, alutaceous, and with scattered punctures having a short fine hair from each; a deep median impression down the front. Antennae dark with the basal four joints in part lighter reddish-brown; joints 2 to 6 subequal and slender, 7 to 11 longer and thicker. Prothorax at least a third wider at base than long, narrowed anteriorly; surface finely alutaceous and finely but not densely punctate, with a white scale from each puncture. Elytra somewhat wider than prothorax, with well developed humeri; a slight swelling below the humerus on the side of the female; surface deeply and moderately densely punctate with no tendency towards striation; a white scale from each puncture tending to be suberect especially on the sides and at apex. Body beneath shining with an aeneous lustre; breast densely punctate; the femora dark, but tibiae becoming reddish-brown towards the apex, tarsi reddish. Length 3 to 3.4 mm.; width 1.8 to 2 mm.

Types. Holotype male and 2 paratypes in M.C.Z. (Type No. 28,410); 1 paratype in U.S.N.M. (Cat. No. 59,473).

Type data. Loma Rucilla and mountains north, 5,000 to 8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Remarks. This species is rather more elongate than the other species from Loma Rucilla and more evenly covered with suberectish hairs, yet the aedeagus, though rounded instead of narrowed at the tip, clearly shows its relationship to them. In shape and pubescence the beetles bear a strong resemblance to *Chalcosicya villosa* but are smaller and show no tendency towards striate punctation on the elytra.

CHALCOSICYA GEMINA n. sp.

(Fig. 19)

About 2.7 mm. in length; oval, lustrous black often with a greenish or bronzy lustre, moderately densely punctate with a white scale from each puncture, on the elytra suberect; prothorax alutaceous and more finely punctate; femora with the apical half dark, at base reddish, tibiae and tarsi reddish-brown.

Head alutaceous with fine scattered punctures, a depression in the middle of the front sometimes lengthened into a median line over occiput; a fine white hair from each puncture, these hairs unusually long and partially concealing the surface. Antennae with basal joints paler, distal joints dark. Prothorax not twice as wide as long, narrowed anteriorly, finely and not very densely punctate, with a hair from each puncture; faintly alutaceous. Elytra rather coarsely and densely punctate even to the apex, the punctures showing a tendency to being striate, with a semi-erect white hair from each puncture; humeri prominent, and a slight swelling on the side below in the female. Body beneath dark, legs reddish-brown with the apical half of the femora dark, often metallic; all femora minutely toothed. Length 2.6 to 3.1 mm.; width 1.7 to 1.8 mm.

Types. Holotype male and 10 paratypes in M.C.Z. (Type No. 28,407); 1 paratype in U.S.N.M. (Cat. No. 59,470).

Type data. Loma Rucilla and mountains north, 5,000 to 8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Remarks. The bicolored femora distinguish this species from *Chalcosicya teres.* It is very close to the following species, *Chalcosicya fraterna*, which bears the same locality label. In fact there is little to distinguish the two except the aedeagus and a slight difference in the punctation. In this species the punctures are distinct to the apex and the elytral hairs are not appressed but suberect. If it were not for the fact that a series of dissected specimens of both species consistently shows the same differences in the aedeagi, I should hesitate to separate them. Another species very closely related to both of these is described later, *Chalcosicya truncata,* also from the same locality, but in this the femora are entirely dark and not bicolored, the antennal joints are dark at the apices, and the scales apparently do not cover all the elytra. But these three species are very close to each other and are to be distinguished mainly by slight but apparently constant differences in the aedeagi.

CHALCOSICYA FRATERNA n. sp.

(Fig. 18)

About 2.7 mm. in length; oval, black, often shining with a bronzy lustre, legs reddish-brown with the apical half of the femora dark; prothorax faintly alutaceous and finely punctate, elytra more coarsely punctate; the white, scale-like hairs appressed; femora minutely toothed.

Head alutaceous and finely punctate, the surface more or less concealed by the white hairs. Antennae with the basal joints reddish-brown, distal joints deeper brown. Prothorax not twice as wide as long, usually alutaceous and finely punctate and evenly covered with white appressed hair-like scales. Elytra with prominent humeri, a faint trace of ridge from humerus down to margin and faint traces of two median costae; a pronounced callosity on each side of scutellum and a lateral depression; punctation much coarser than on prothorax and denser, becoming finer and sparser towards apex, the white scale-like hairs closely appressed. Body beneath black under the fine pale pubescence; breast not coarsely punctate; legs reddish-brown with apical half of femora dark; femora minutely toothed. Length 2.6 to 3 mm.; width 1.5 to 1.8 mm.

Types. Holotype male and 3 paratypes in M.C.Z. (Type No. 28,408); 1 paratype in U.S.N.M. (Cat. No. 59,471).

Type data. Loma Rucilla and mountains north, 5,000 to 8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Other material. Valle Nuevo, S.E. of Constanza, about 7,000 ft., Dominican Republic, Aug. 1938, P. J. Darlington.

Remarks. As stated previously this species is very similar to the preceding, *Chalcosicya gemina*, and to be distinguished by the slight difference in the aedeagus and by the appressed and not suberect scales on the elytra.

CHALCOSICYA TRUNCATA n. sp.

(Fig. 17)

About 3 mm. in length; oval, black, shining with a coppery, greenish or even bluish lustre, antennae pale with the apices of each joint dark, femora dark metallic, tibiae and tarsi reddish-brown; thorax alutaceous and finely punctate, elytra more coarsely punctate and very shiny; the white scales found only about the edges.

Head dark metallic with the labrum reddish, alutaceous, with fine punctures and a short white scale from each puncture, not concealing the surface below; a median depression in lower front becoming broader and deeper anteriorly. Antennae reddish-brown with the apices of each joint, particularly the distal joints, darkened; joints 2 to 6 slender and subequal, 7 to 11 longer and thicker. Prothorax not twice as long as broad, narrowed towards apex, finely alutaceous, and finely and moderately densely punctate, often with a smooth vertical line down the middle; the white scales only about the edges. Elytra broadly convex, with prominent humeri and a basal callosity on each side of scutellum, but no ridges or costae; surface very shiny; more coarsely punctate than prothorax, with a tendency, towards the suture, of being striately punctate, the punctures at the apex becoming fine; the scale-like hairs present only at sides and apex. Body beneath dark, often with a metallic lustre, finely alutaceous, and densely covered with light white hairs; breast almost striately punctate; legs reddish-brown with the femora dark metallic; all femora finely toothed. Length 2.5 to 3.5 mm.; width 1.8 to 2.2 mm.

Types. Holotype male and 14 paratypes, in M.C.Z. (Type No. 28,409); 1 paratype in U.S.N.M. (Cat. No. 59,472).

Type data. Loma Rucilla and mountains north, 5,000 to 8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Remarks. Although closely related to *Chalcosicya gemina* and *fraterna,* this species is more easily distinguishable, since the femora are entirely dark and the antennal joints pale with the apices darkened. The surface of the head is less concealed by the white hairs, and on the thorax and elytra, unless all the specimens have had their scales rubbed off, the scales are only about the edges.

Chalcosicya parvula n. sp.

(Fig. 21)

About 2.4 mm. in length; oval, lustrous black, the head and femora sometimes with a greenish tinge, basal joints of antennae, tibiae, and tarsi, and usually the basal half of the anterior pairs of femora reddish-brown, although in one specimen only the middle femora pale at base; only traces of white scales about the edge on the upper surface.

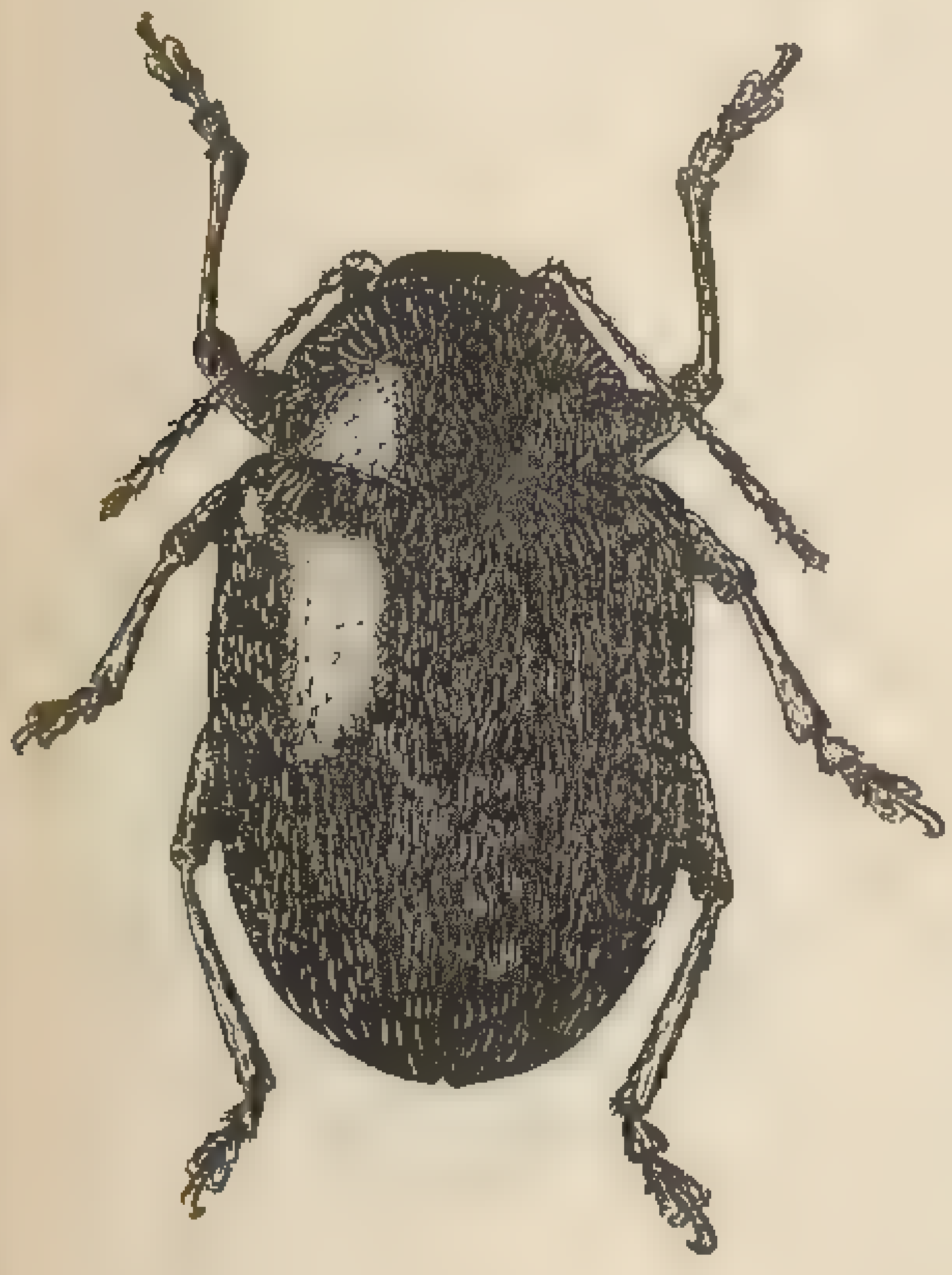
Head usually entirely dark, one specimen with reddish mouthparts; alutaceous, with fine scattered punctures having a short white hair from each; a depression in the middle of the front usually not extending up on occiput. Antennae for the most part dark, the basal joints in part reddish-brown, joints 2 to 6 slender and subequal, remainder longer and thicker. Prothorax almost twice as wide as long, narrowed anteriorly, faintly alutaceous and with scattered, not dense punctation; short white scales about the edges. Elytra almost as broad as long, with prominent humeri and moderately coarse and not very dense punctation having a tendency to be striate in basal part; no sign of ridging on the side; scales on all four specimens gone except around edges of elytra. Body beneath with pubescence short and inconspicuous; dark piceous, the femora with a greenish lustre, the basal half of anterior pairs of femora and the tibiae and tarsi reddish-brown, in one specimen only the middle femora with pale base, femora finely toothed. Length 2.2 to 2.4 mm.; width 1.5 mm.

Types. Holotype male and 2 paratypes in M.C.Z. (Type No. 28,404); 1 paratype in U.S.N.M. (Cat. No. 59,468).

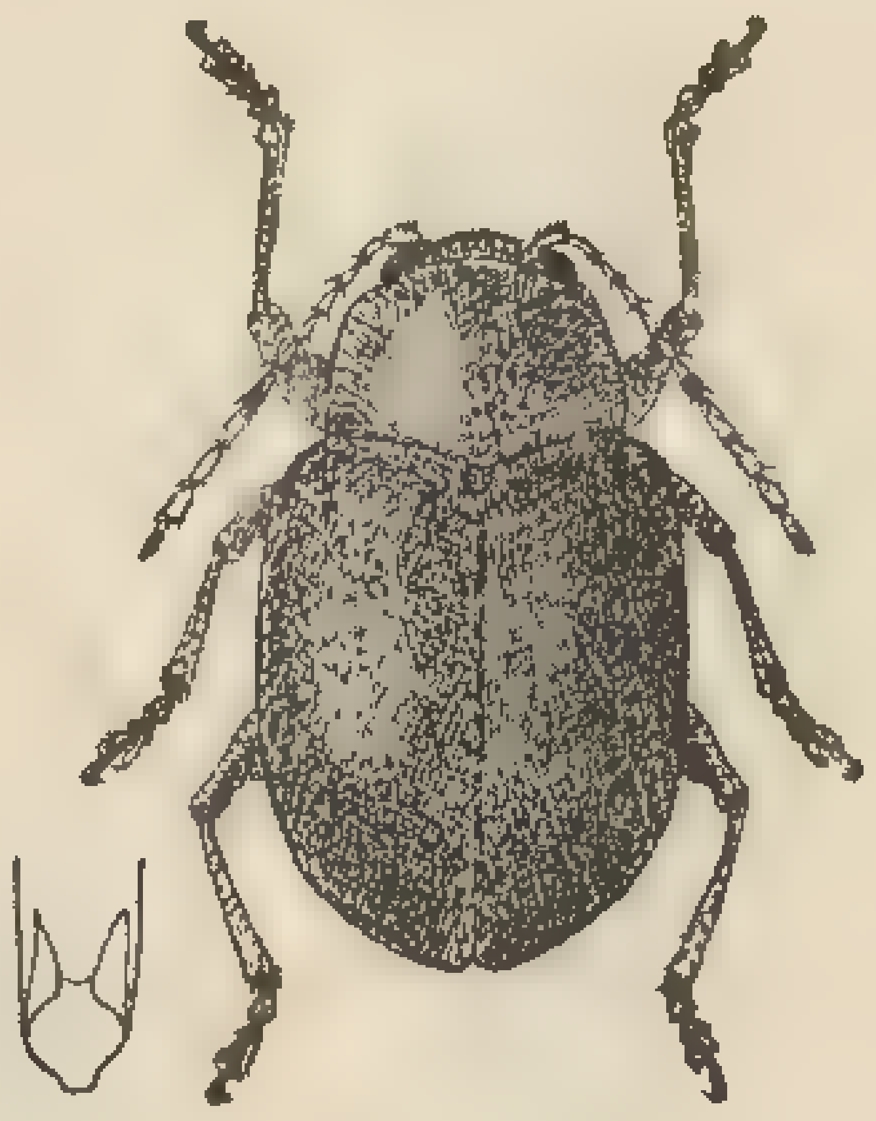
Type data. Loma Rucilla and mountains north, 5,000 to 8,000 ft., Dominican Republic, June 1938, P. J. Darlington.

Remarks. Although in the same group as the four other species from Loma Rucilla, and having an aedeagus similar in the shape of its tip, this tiny species because of its size and black coloring is easily separated. In the coloring of the legs there is still another variation: the two anterior pairs of femora are usually bicolored and the hind femora entirely dark, although in one of the four specimens only the middle femora are pale at the base.

PLATES



1. Chalcosicya darlingtoni



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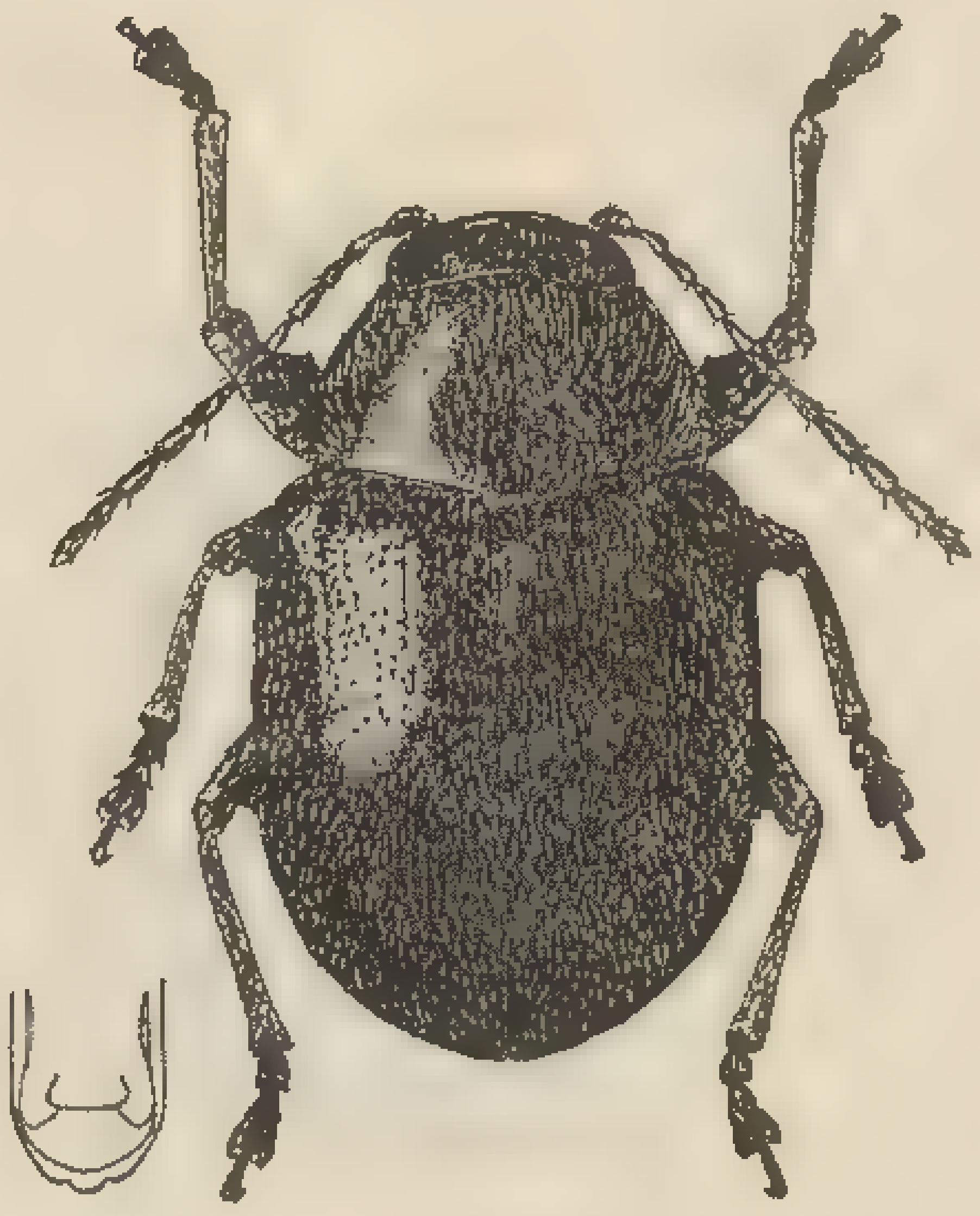
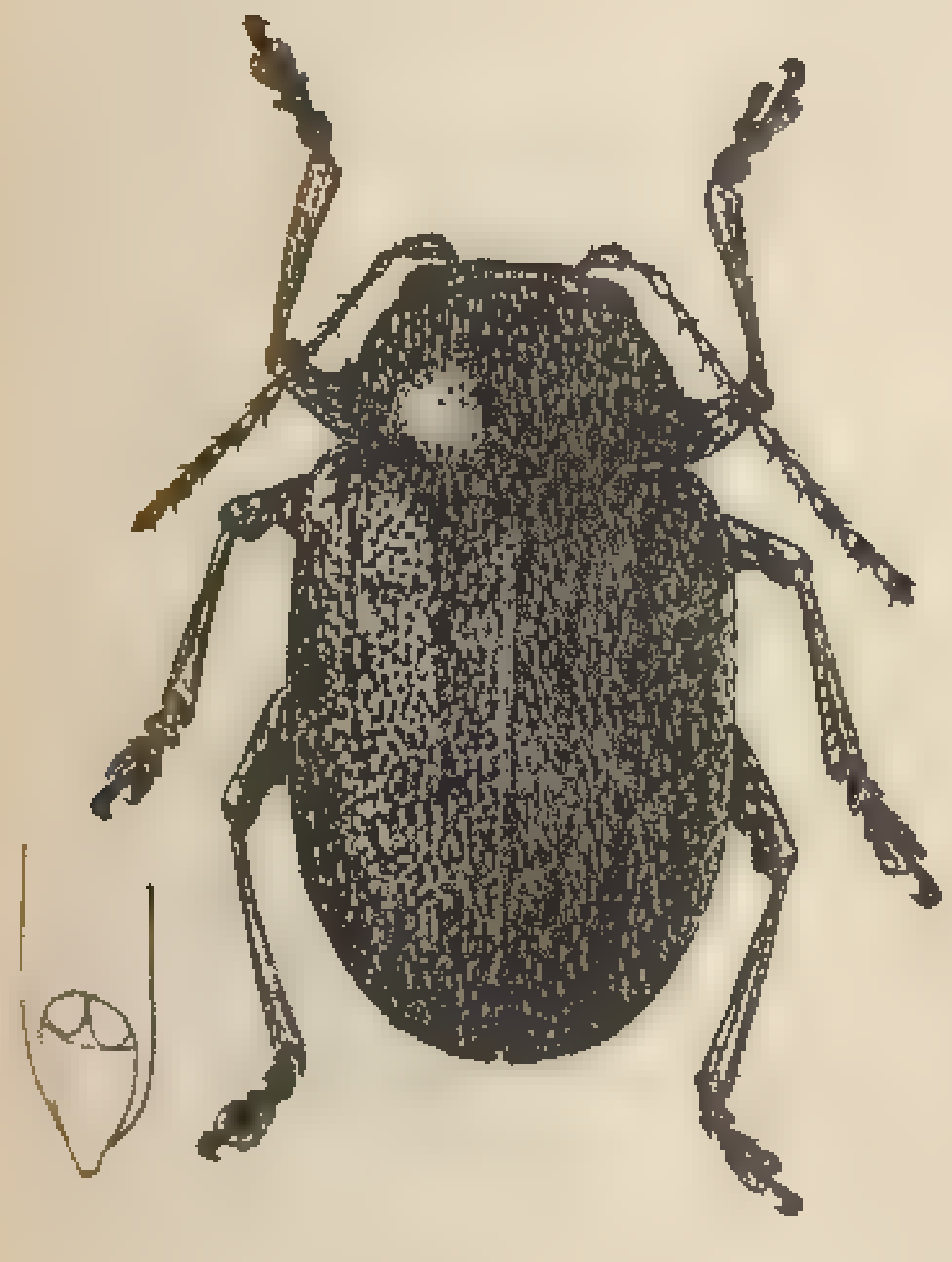
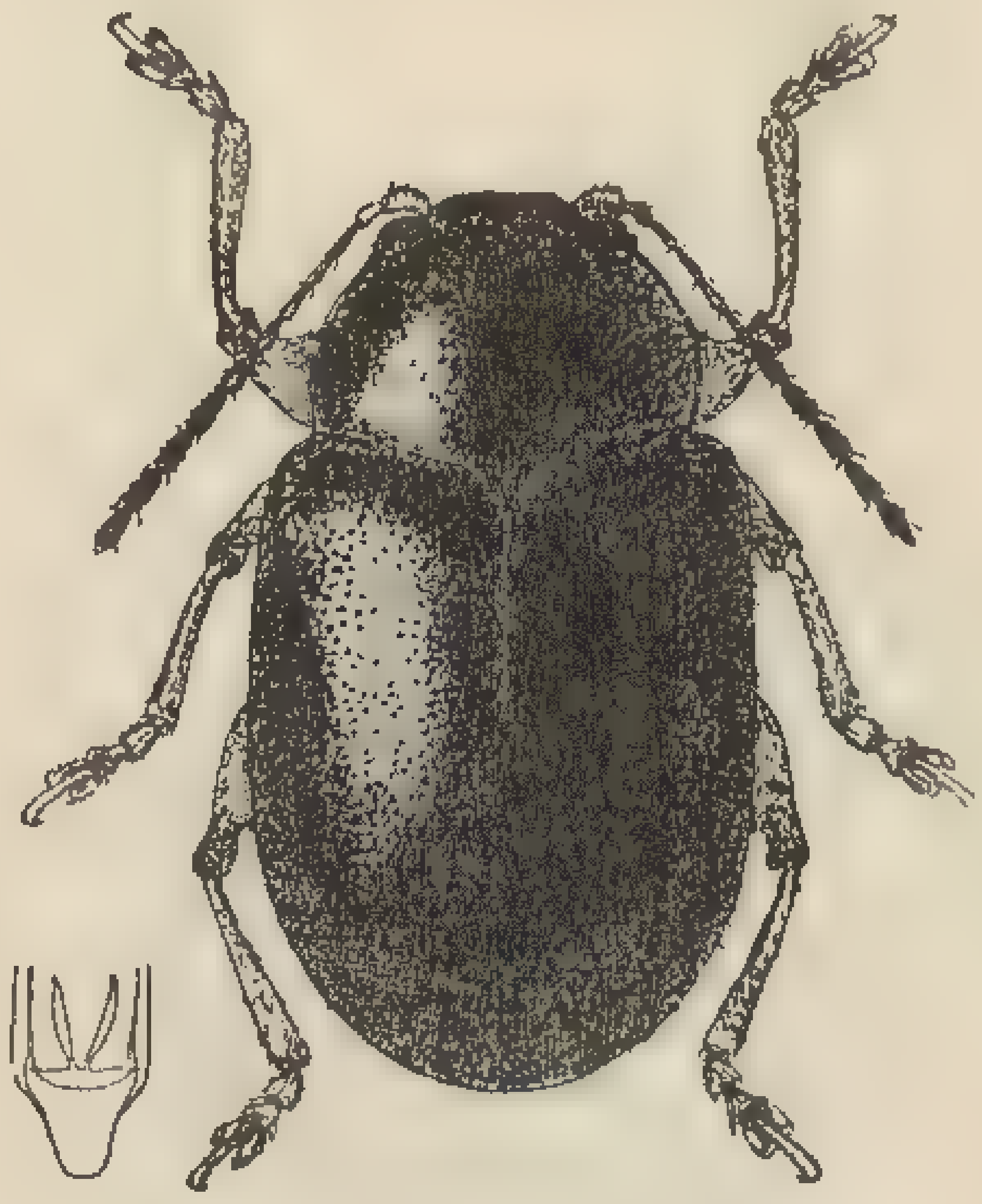


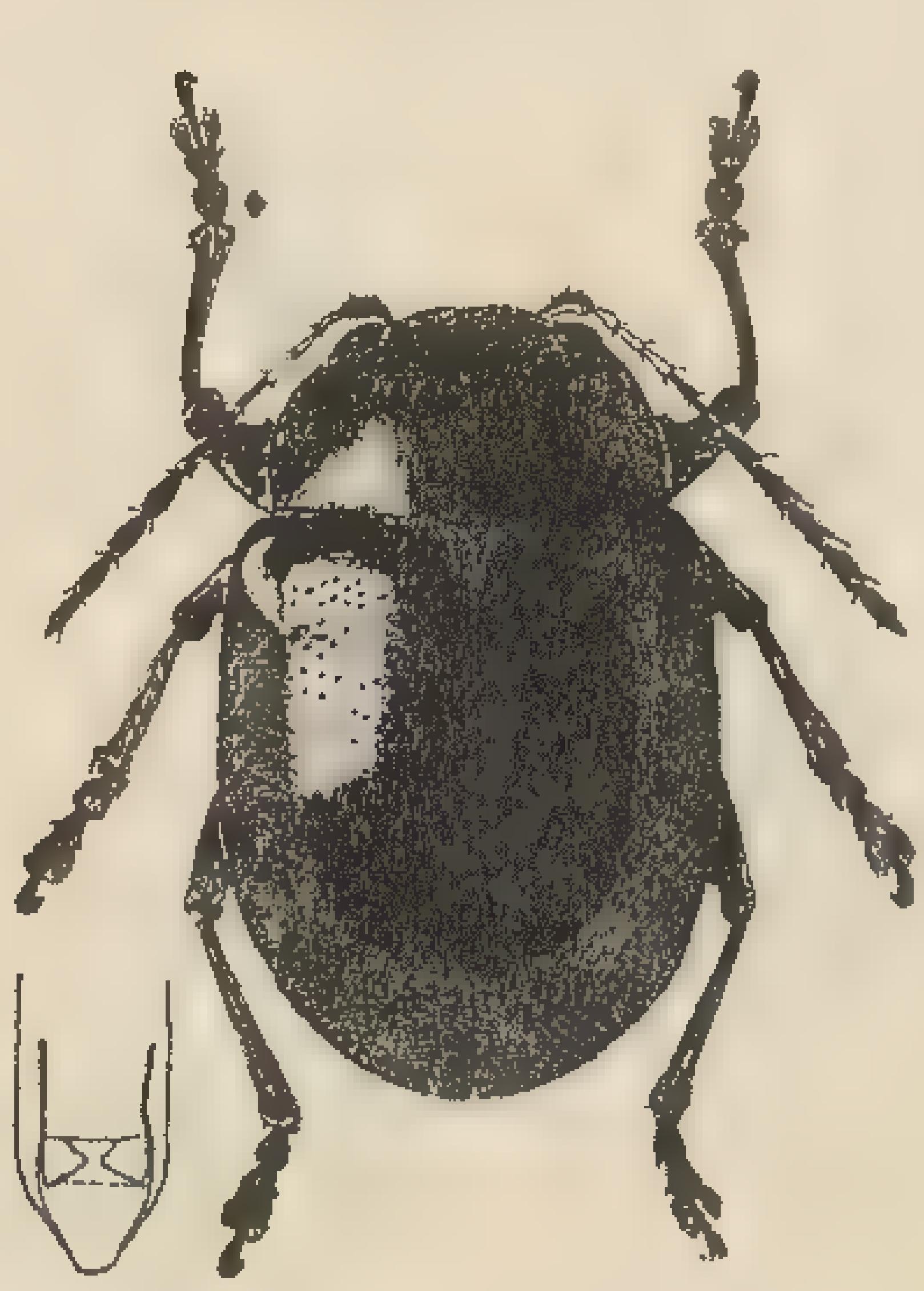
3. C. eleutherae



4. C. insularis Blatchley



5. C. senilis



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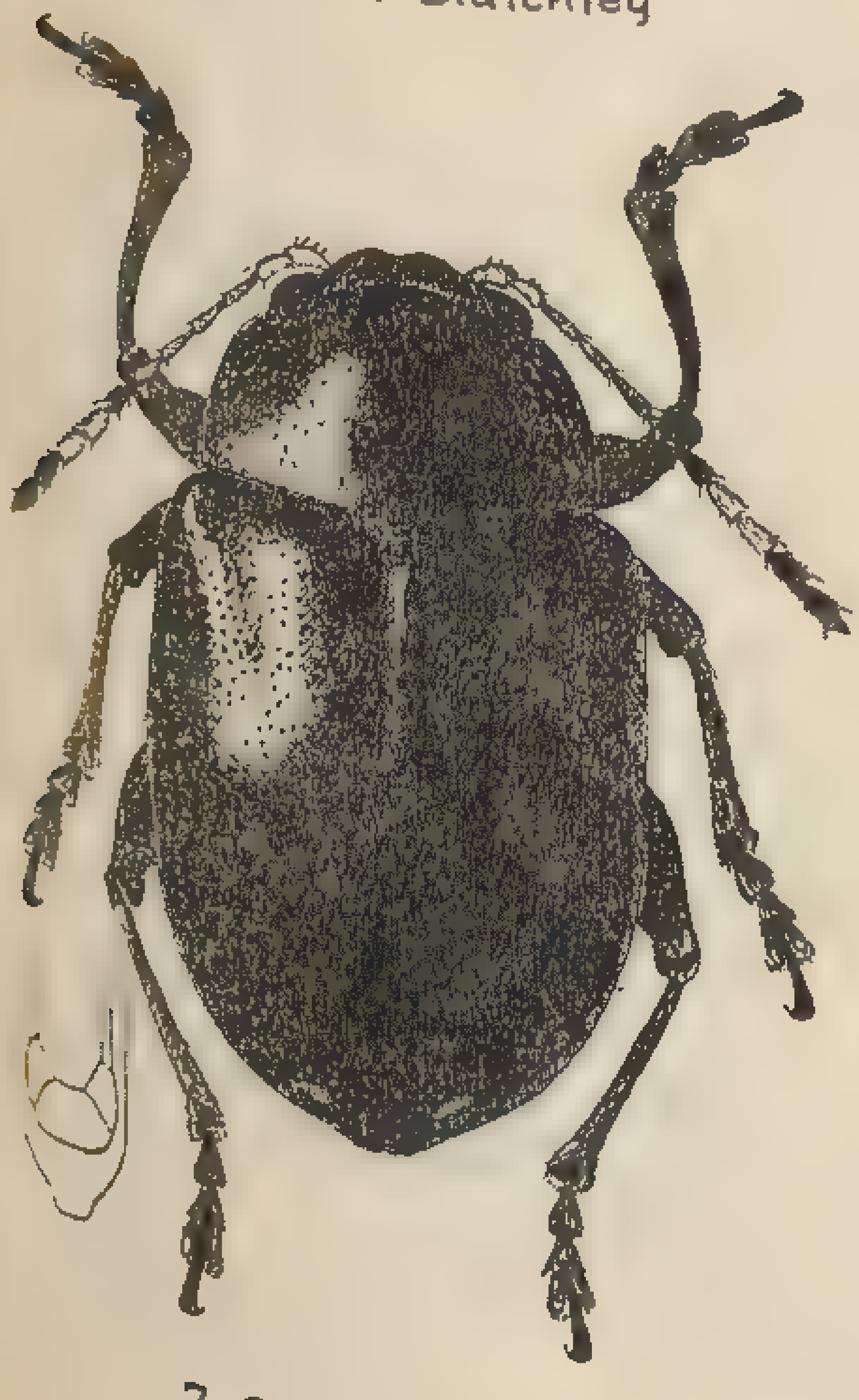

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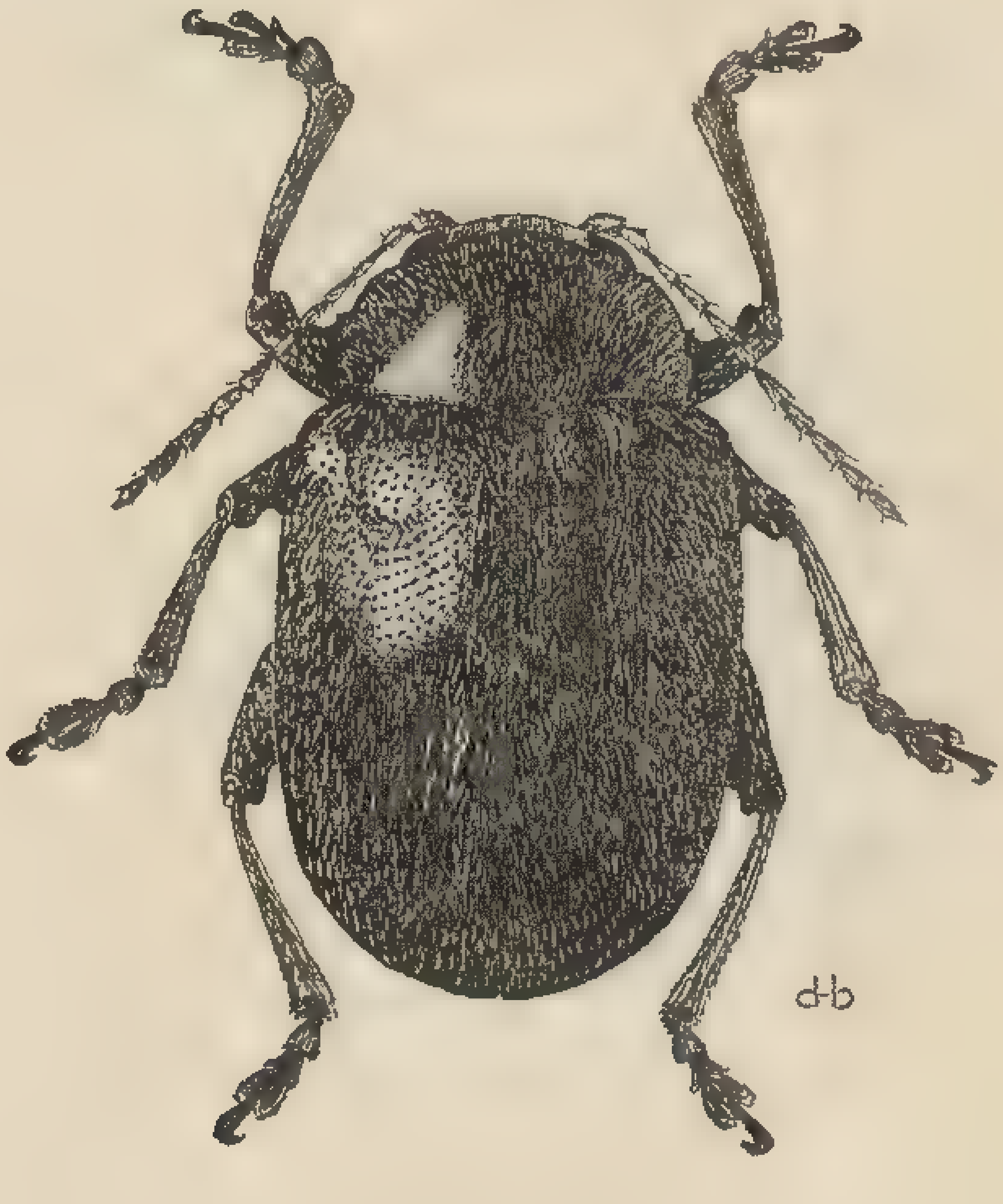
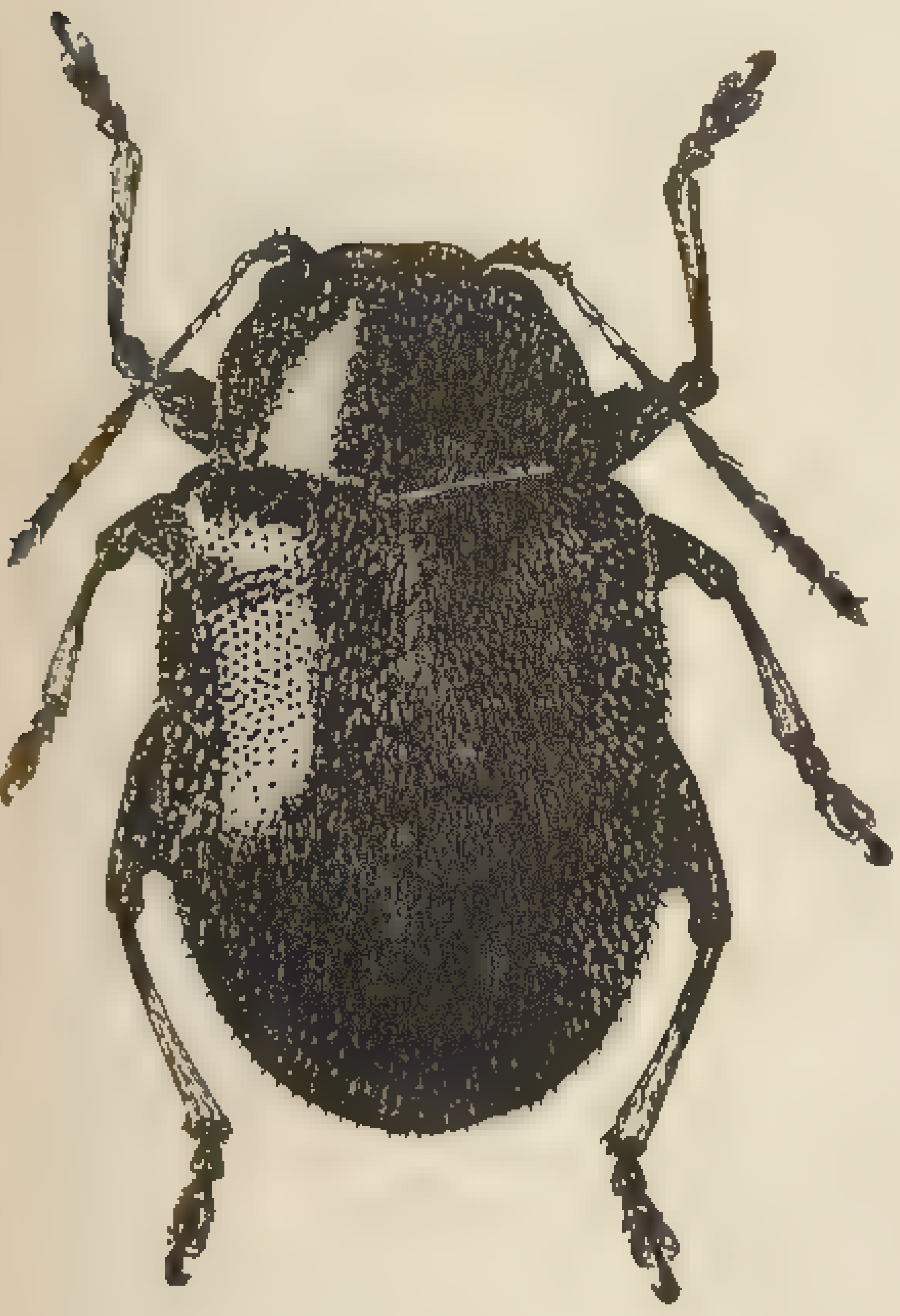


8. C. convexa



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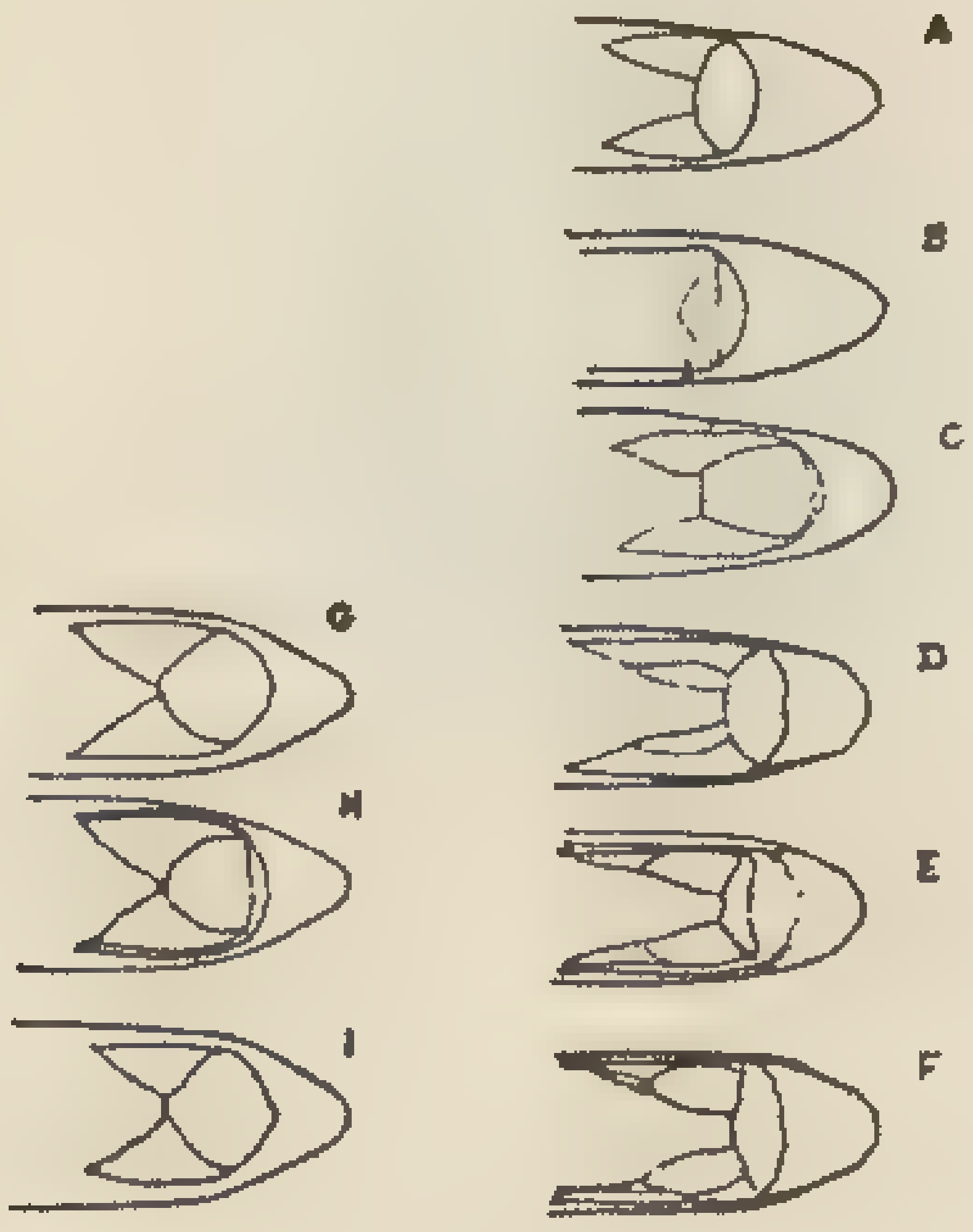

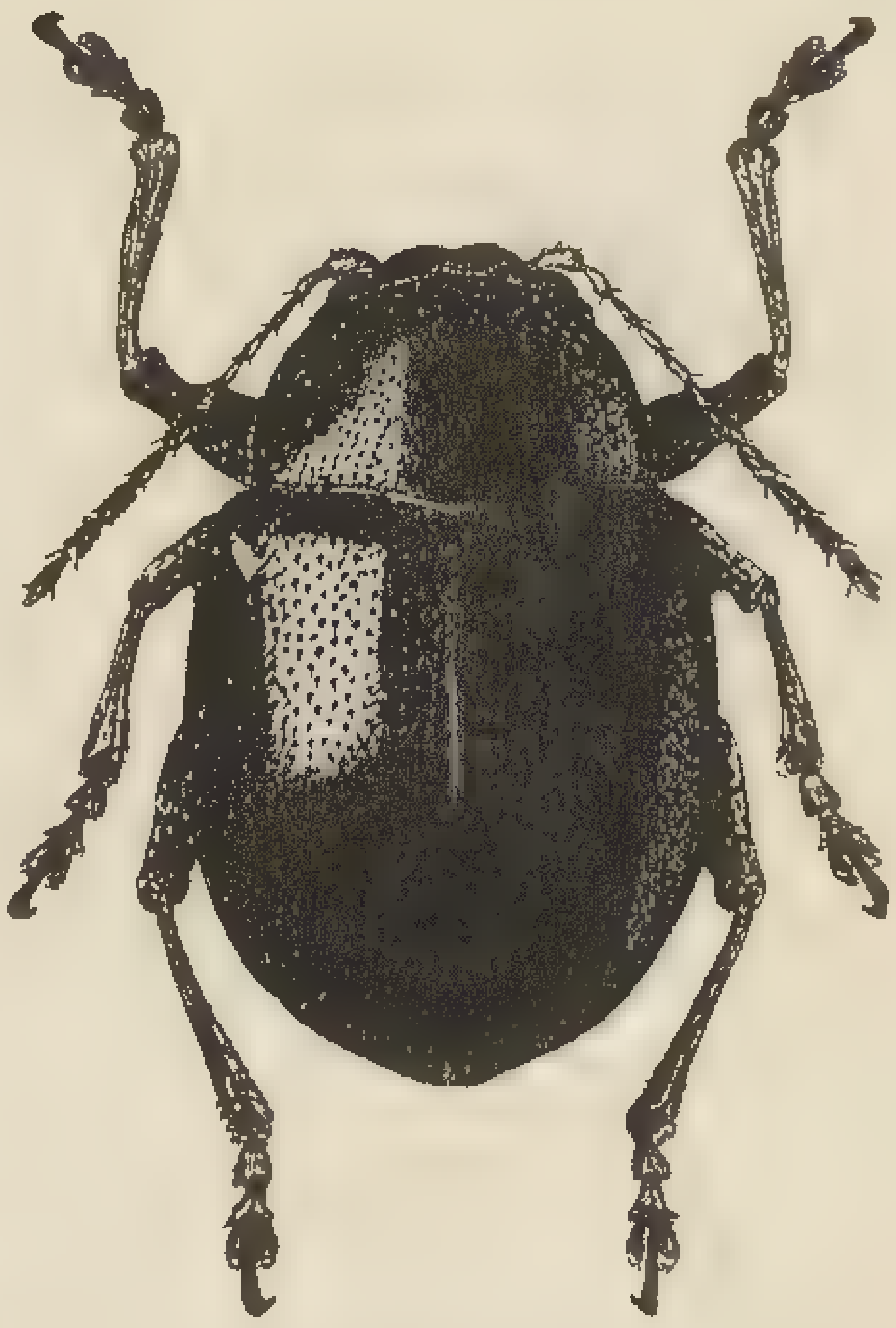

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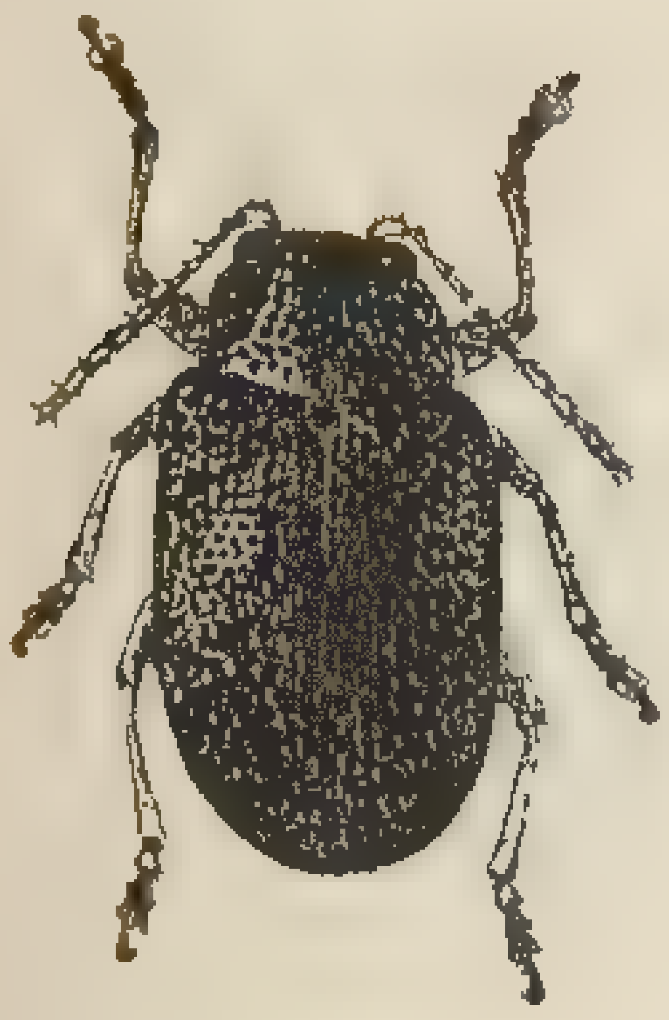
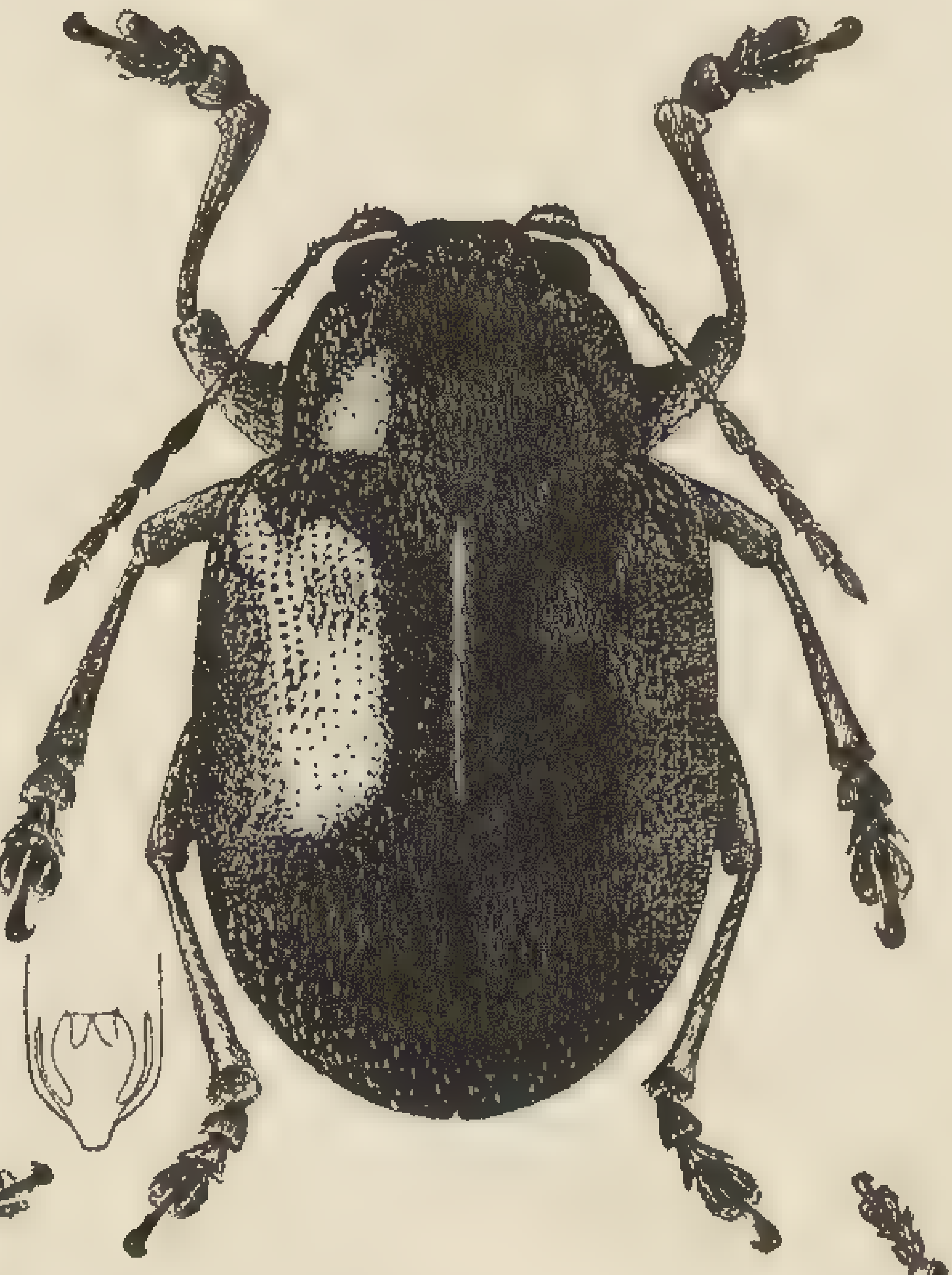


11. C. parsonsi



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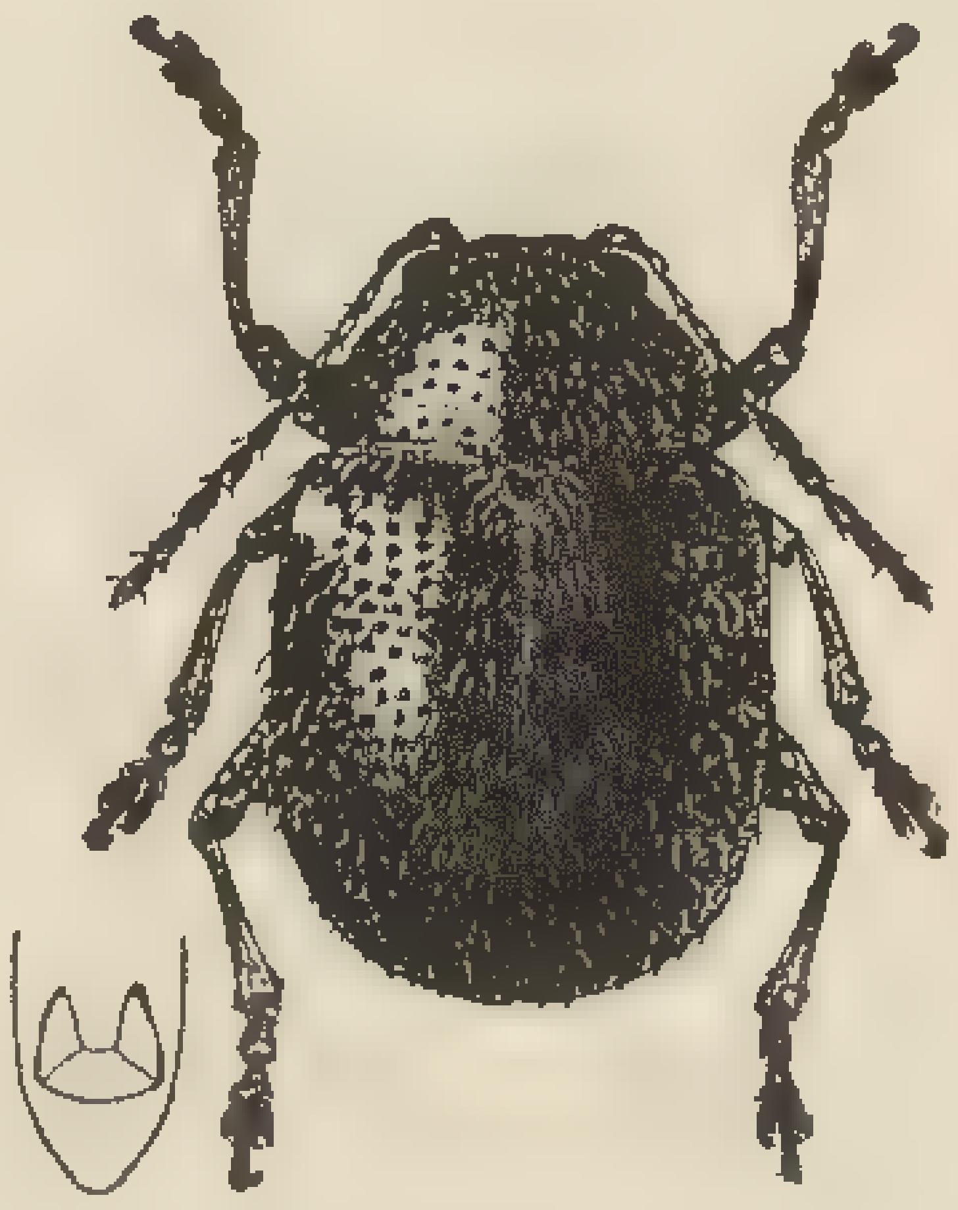
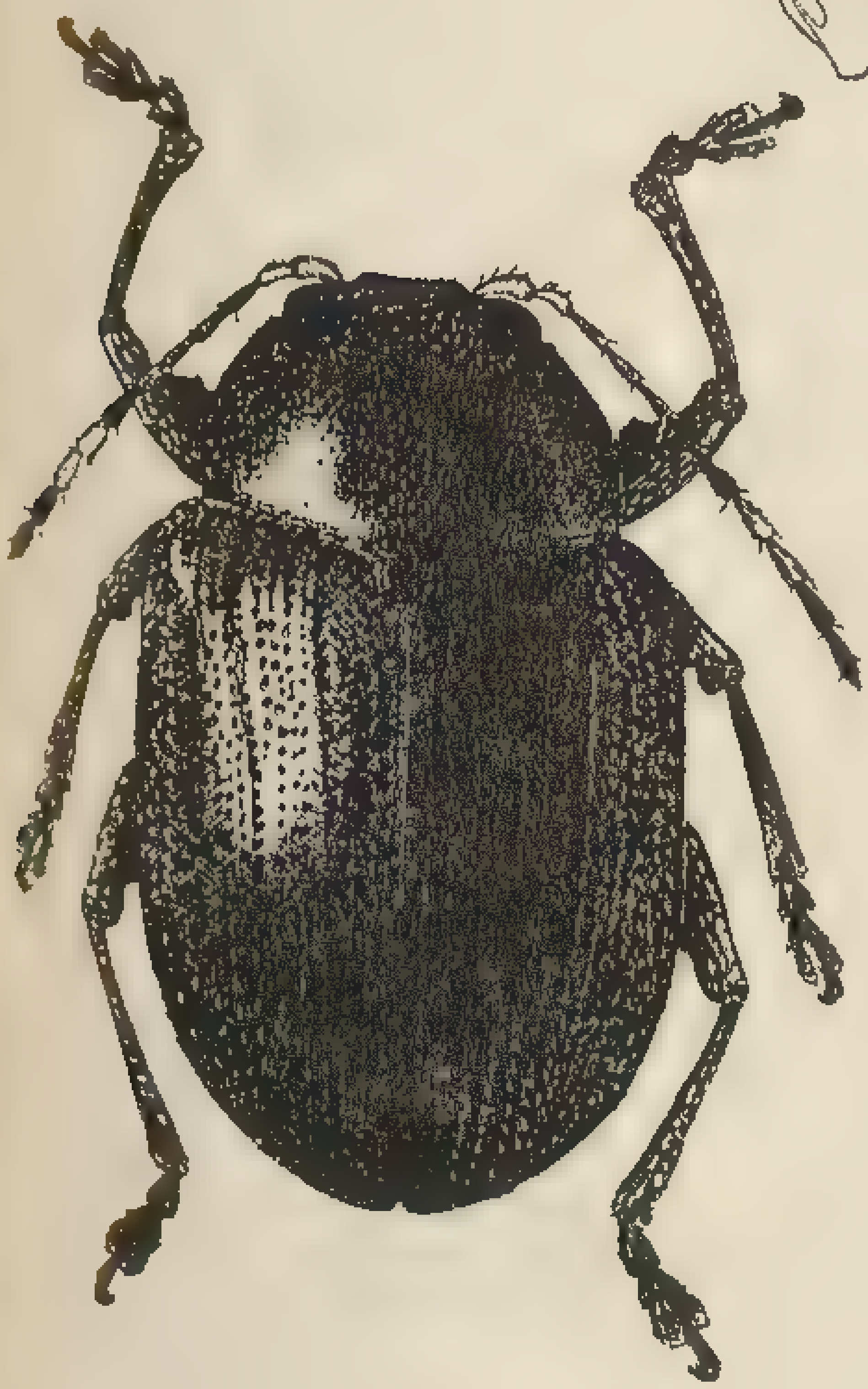


13. C. rotunda



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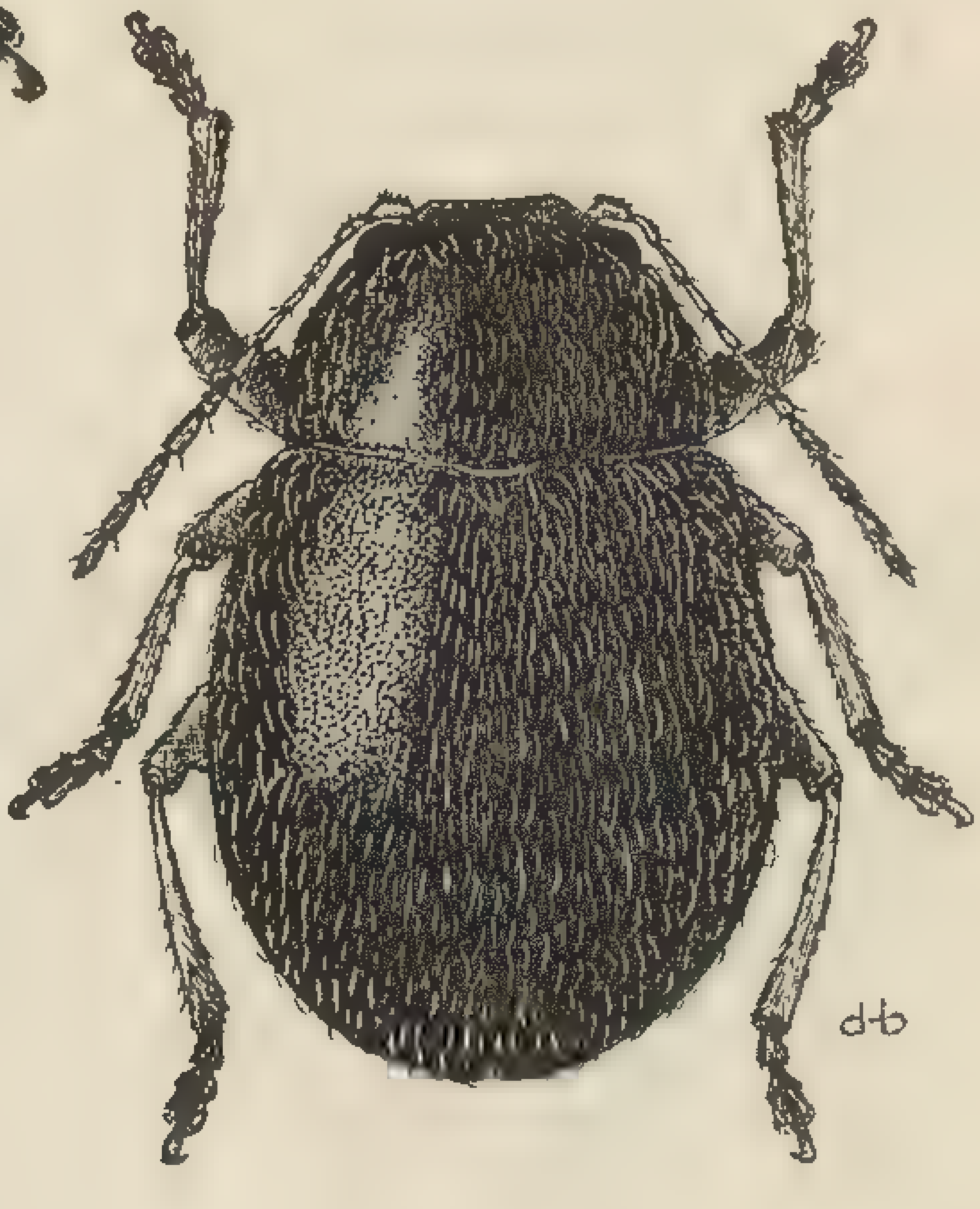

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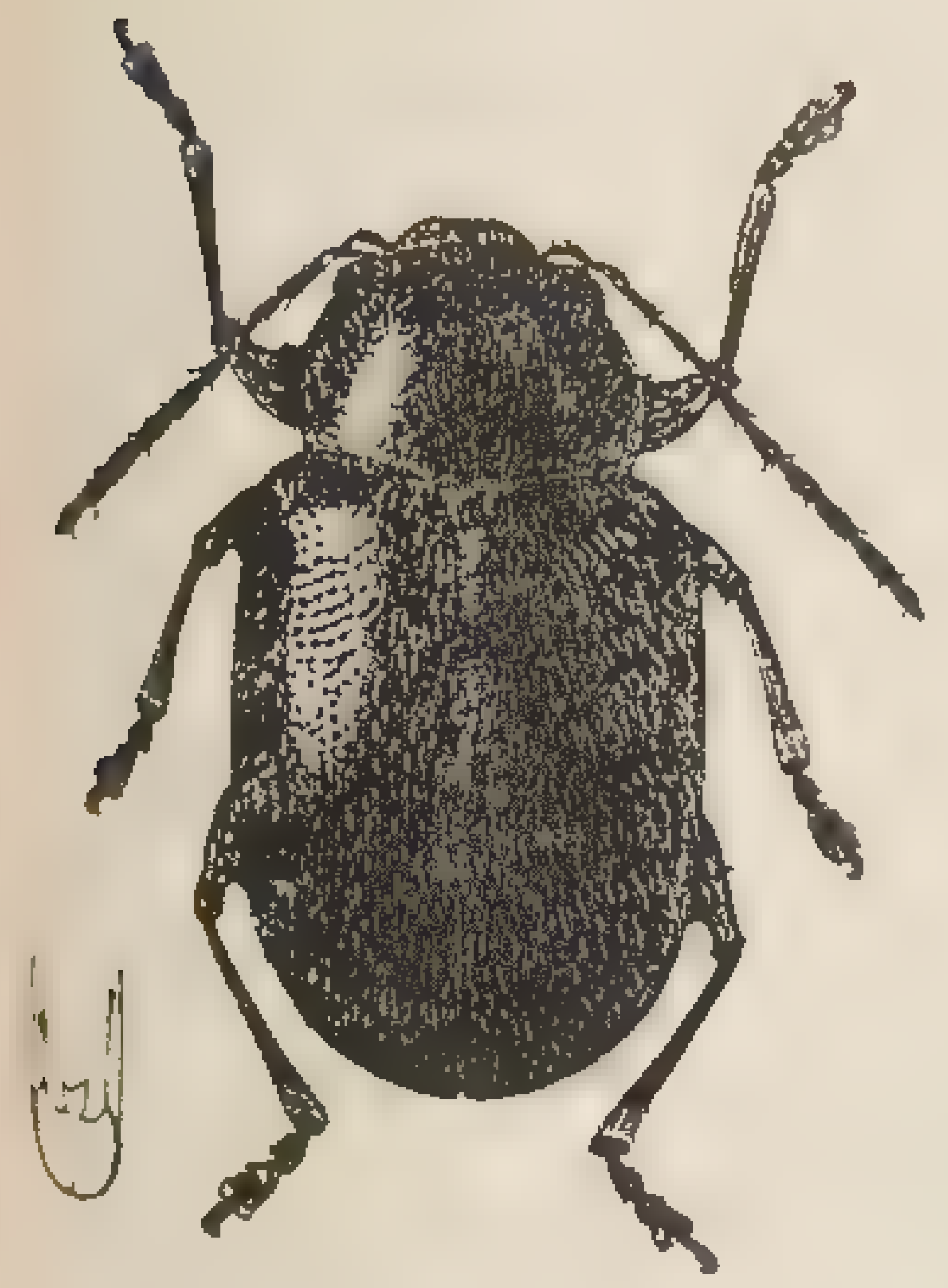

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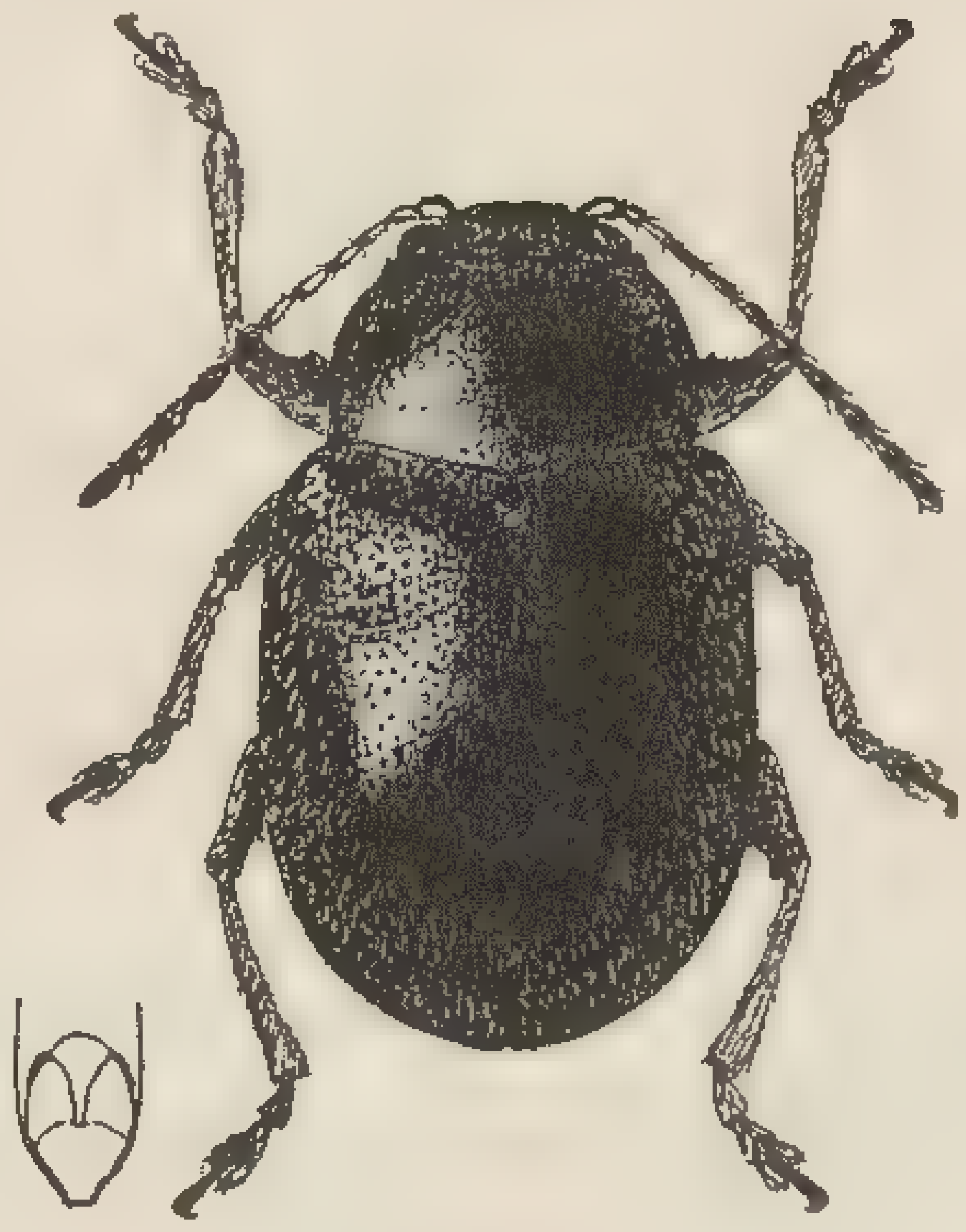

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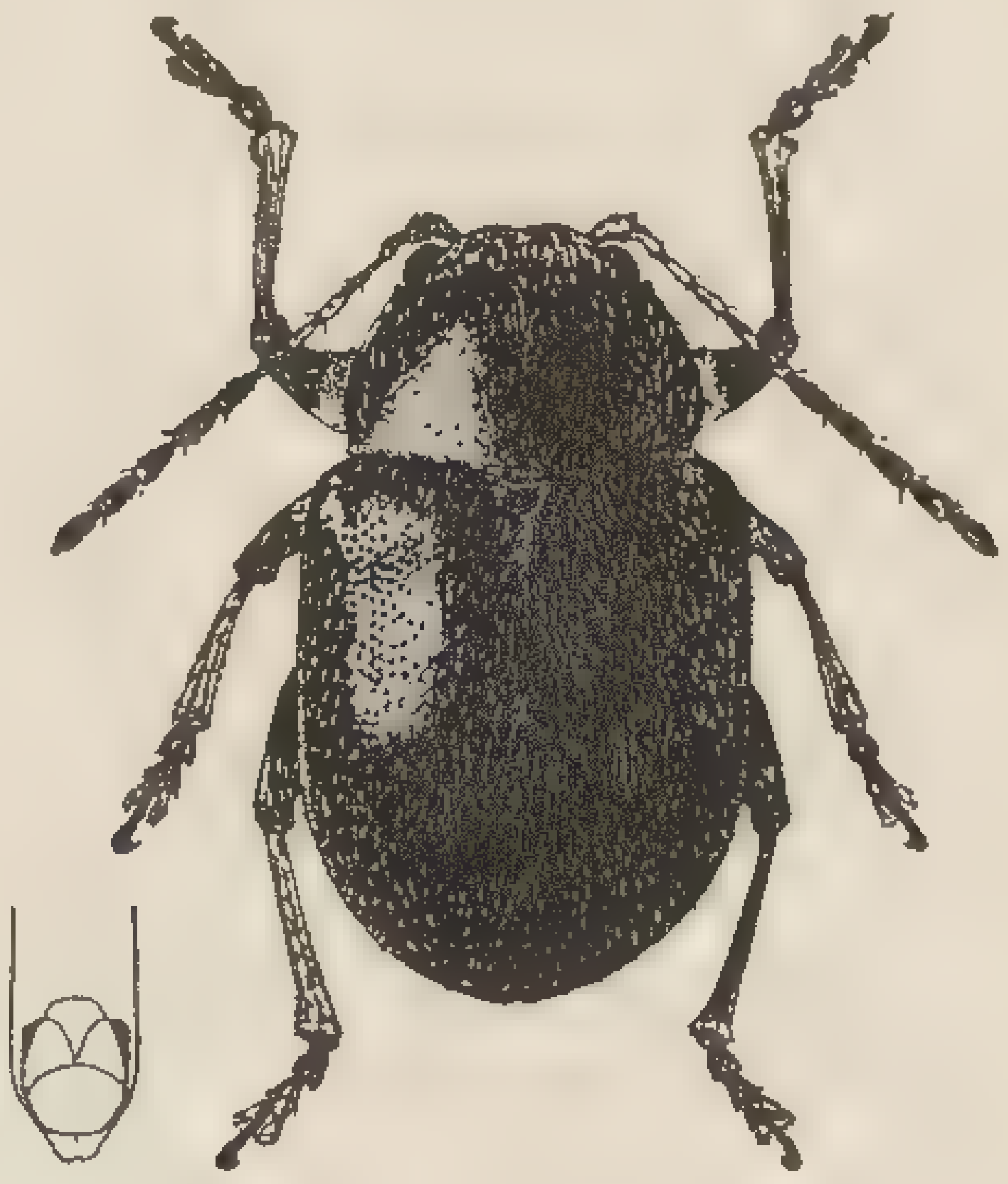

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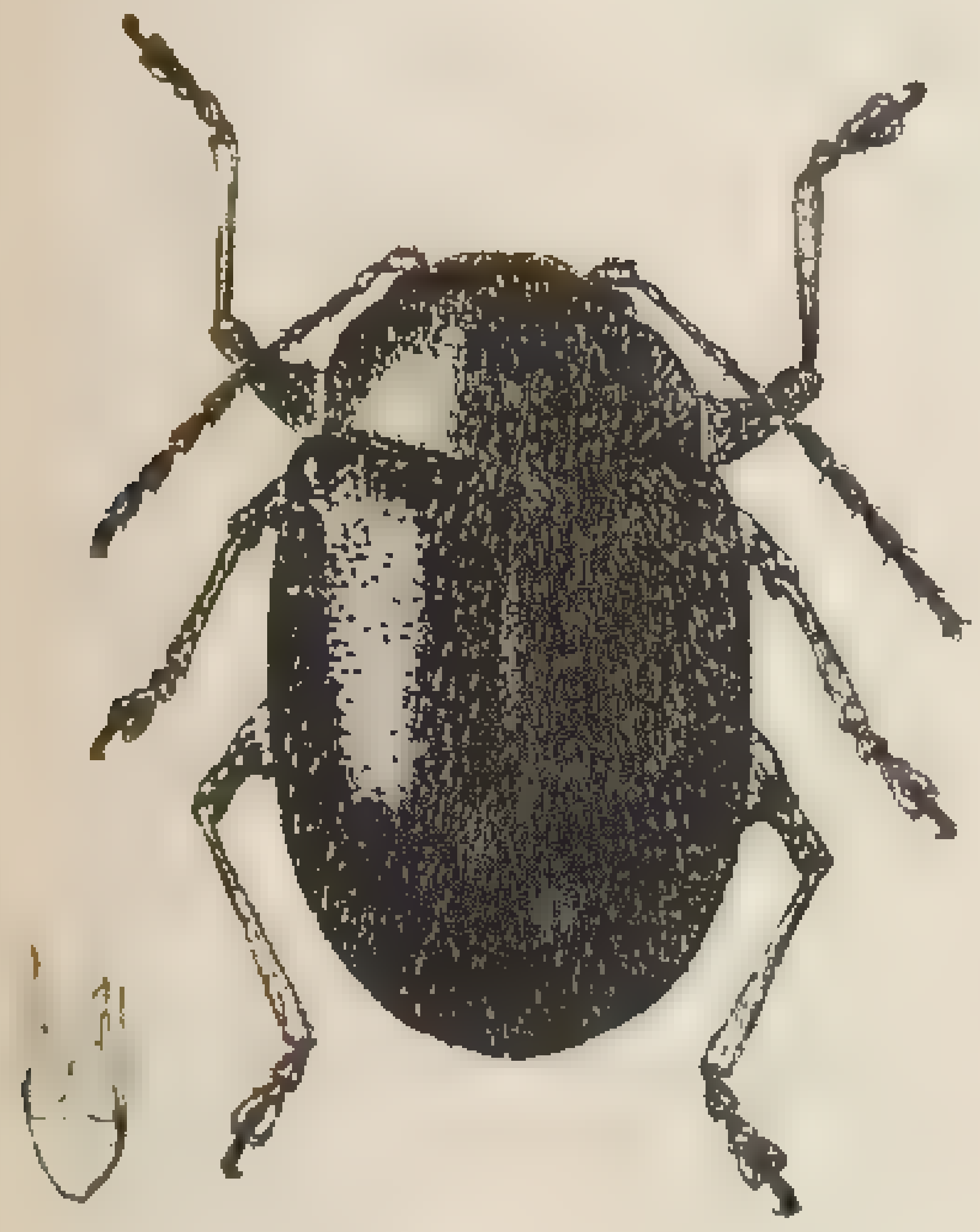

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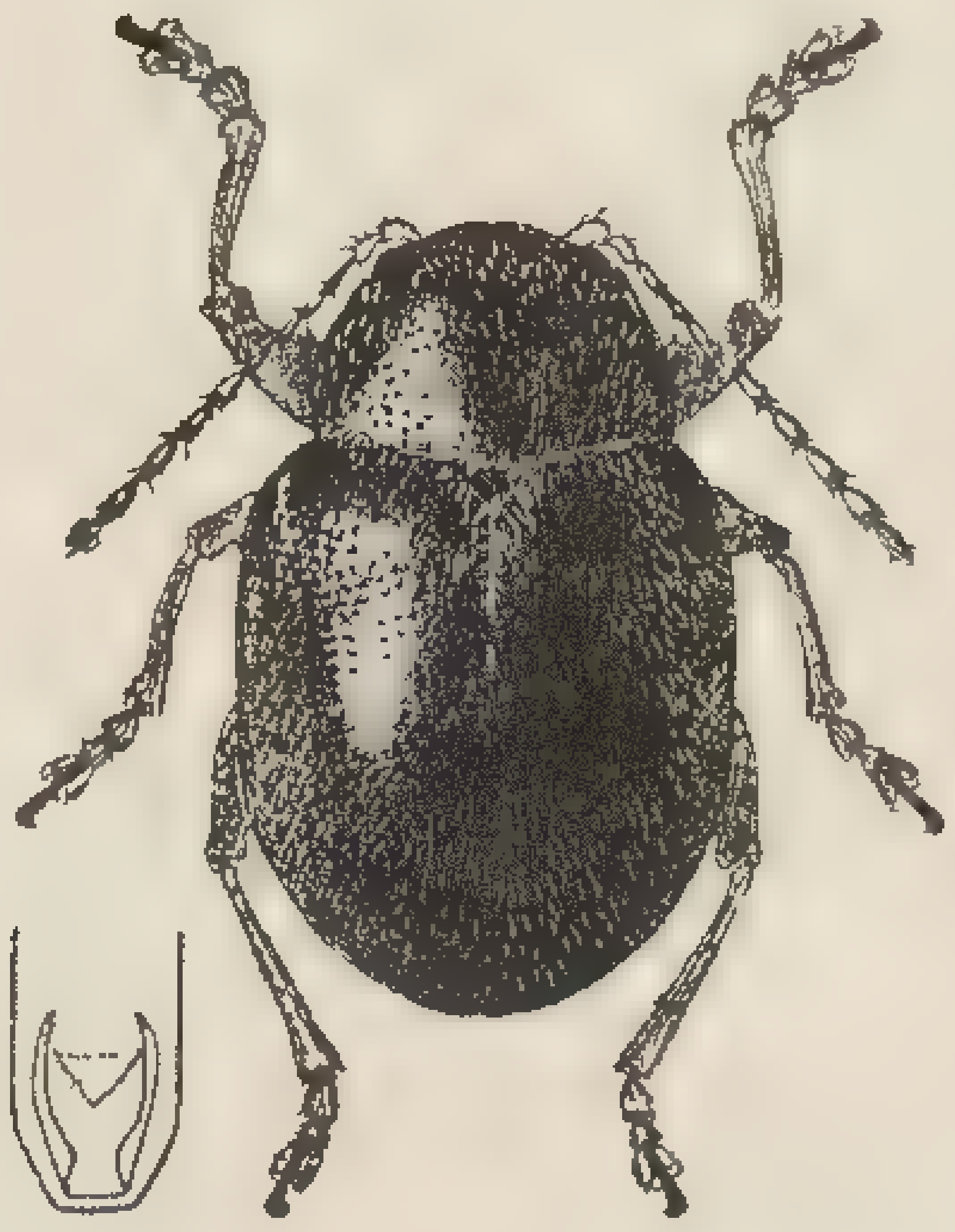

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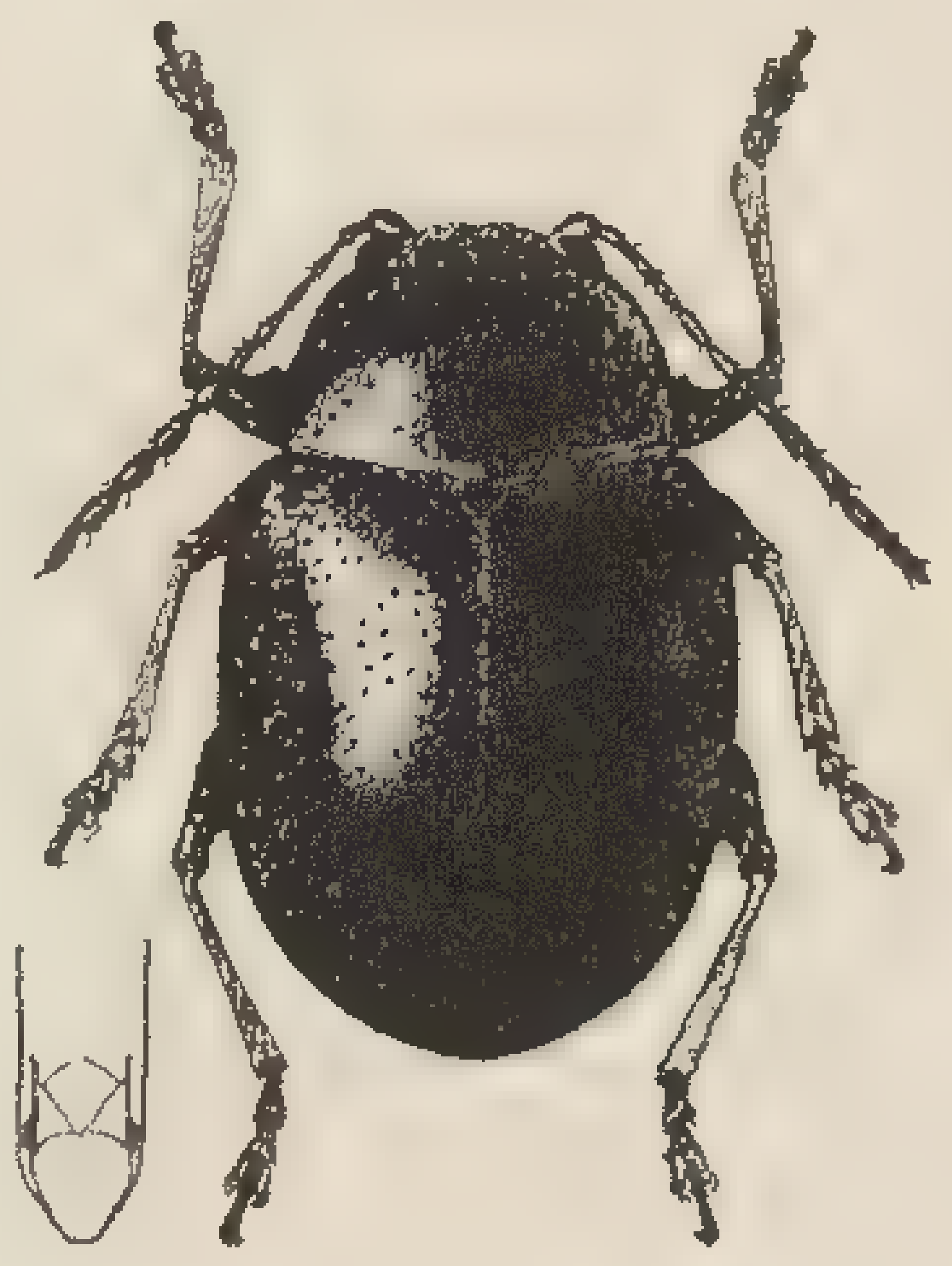

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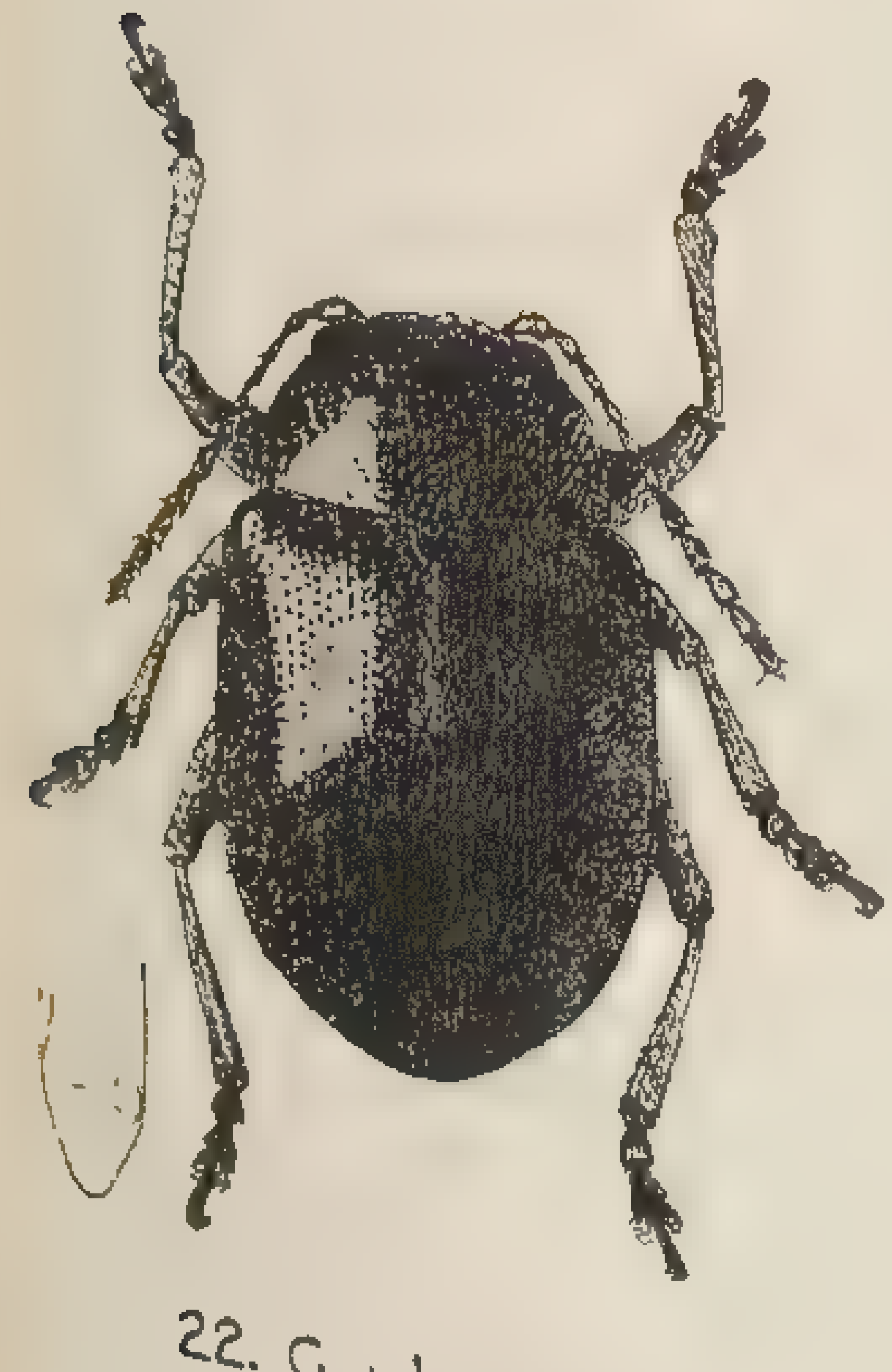

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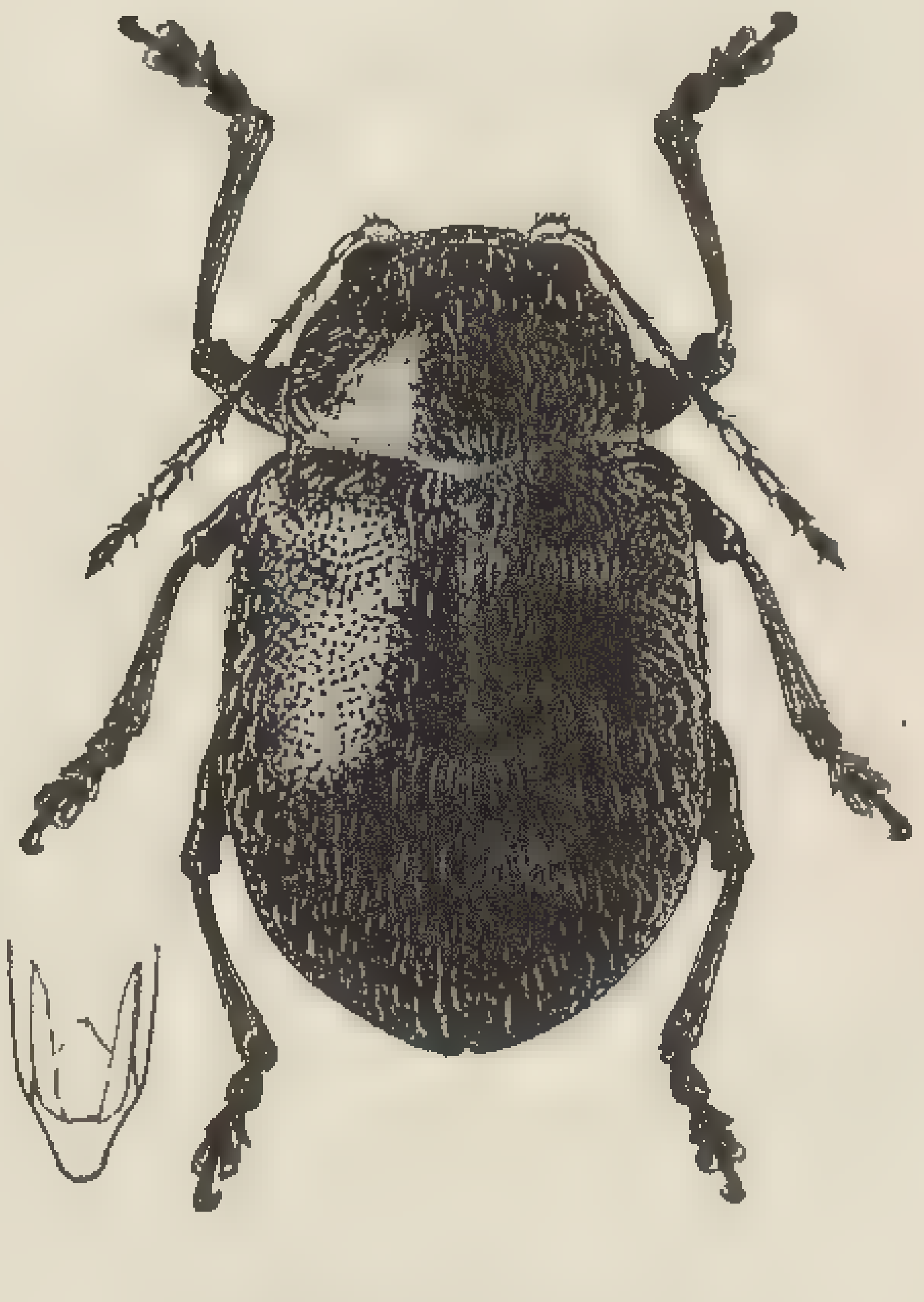
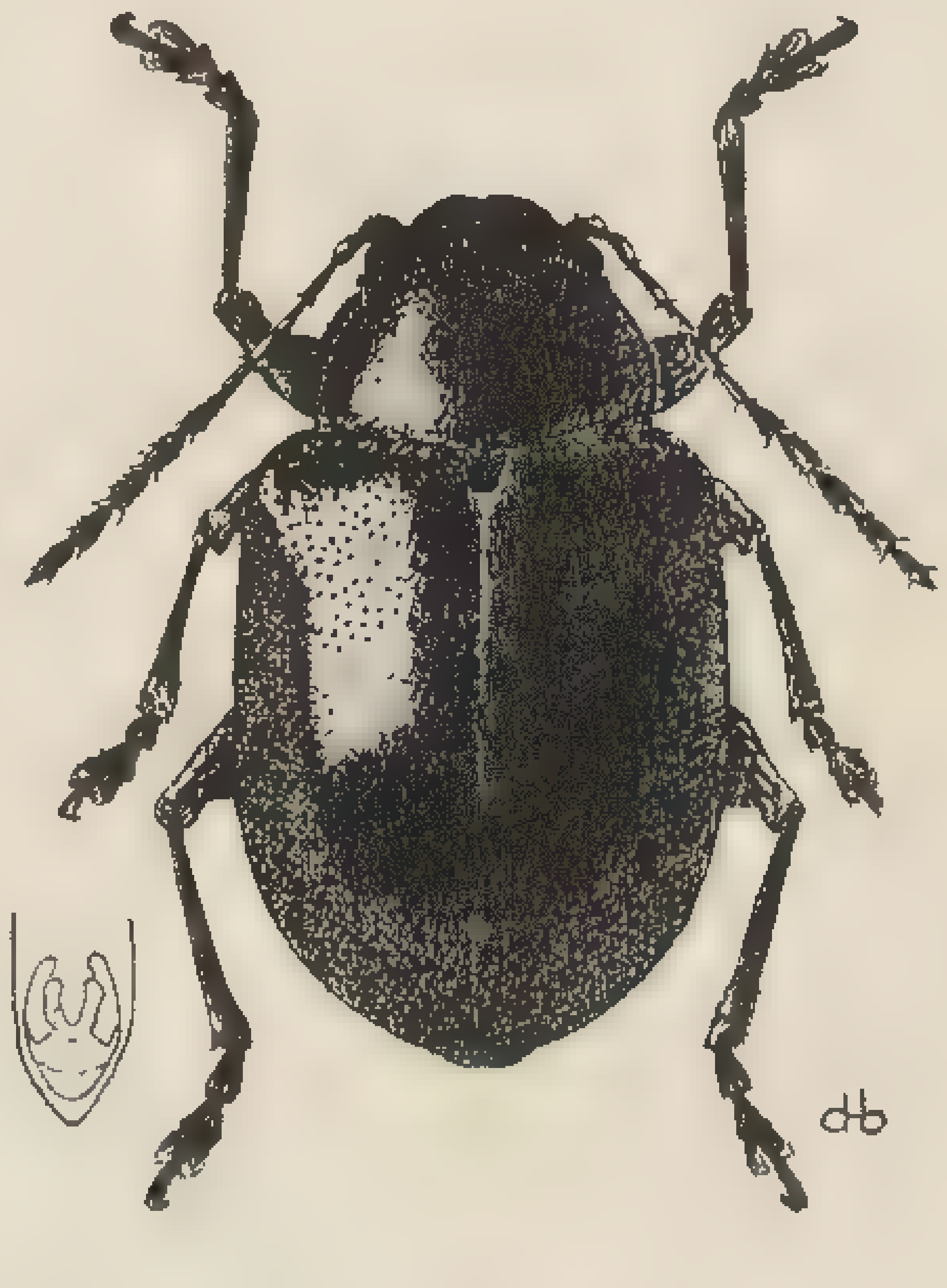


23. C. ditrichota



24. C. acuminata

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AT HARVARD COLLEGE
Vol. 106, Nos. 8 and 9

No. 8. FORAMINIFERA ECOLOGY OFF PORTSMOUTH, NEW HAMPSHIRE

By Fred B Phleger

AND

No. 9. FORAMINIFERA SPECIES OFF PORTSMOUTH, NEW HAMPSHIRE

By Frances L. Parker

With Six Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM
April, 1952

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No 8 — *Foraminifera Ecology Off Portsmouth, New Hampshire*[1]

By Fred B Phleger

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[1] Manuscript received for publication October 2, 1951.

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INTRODUCTION

The marine area covered in this study is in the western Gulf of Maine off coastal northern Massachusetts, New Hampshire, and southern Maine. It extends from Ipswich Bay and Cape Ann on the south to a few miles north of Portsmouth, New Hampshire, on the north, a straight line distance of about 28 miles. Samples were taken from nearshore to approximately 30 miles offshore in the north and to 18 miles offshore in the south, covering an area of about 600 square miles.

The eastern, seaward limit is at Jeffreys Ledge, a relatively shoal area covered with sand and stones of glacial origin. Shoreward from Jeffreys Ledge is a rather elongate basin trending north-northeast which is open at the northern end but closed at the south by the convergence of Jeffreys Ledge and Cape Ann. This will be called the "Portsmouth basin" in this report. There are steep slopes on the sides of the Portsmouth basin and it is constricted near the southern end by submerged ridges extending from Jeffreys Ledge and the Isles of Shoals. Landward from the Portsmouth basin in the northern section there is a submerged topography similar to the glacial topography found on the nearby land. This northwest section has a rough topography with many small hills and enclosed basins. The southern part of the nearshore area is a relatively smooth sand plain grading seaward into a mud and sand plain. Maximum depth of water in the area covered is less than 200 meters.

The purpose of this study is to examine some of the effects of the environment on the distribution of shallow-water benthonic Foraminifera and especially the effect of type of sediment. The area was chosen because all the principal nearshore marine sediment types are represented, except coral. Also the distribution of temperature and salinity is moderately well known in the area.

Most of the bottom samples were collected by David B. Erikson and George Kellogg during the summer of 1946, using the facilities of the Woods Hole Oceanographic Institution. Laboratory analysis of many of the samples was done by Jean F. Peirson. Field work was supported by Office of Naval Research Contract No. N6onr-277, and laboratory work by Contract N6onr-277, Task Order III, with the Woods Hole Oceanographic Institution.

METHOD OF STUDY

Field Work

Stations for bottom samples are located in a series of traverses which form a closely spaced grid pattern. Stations are spaced ½ to 1 mile apart on each traverse and traverses are 1 to 2 miles apart; a total of 738 samples was collected. The geographic position of each sample used in this paper is given in Table 1.

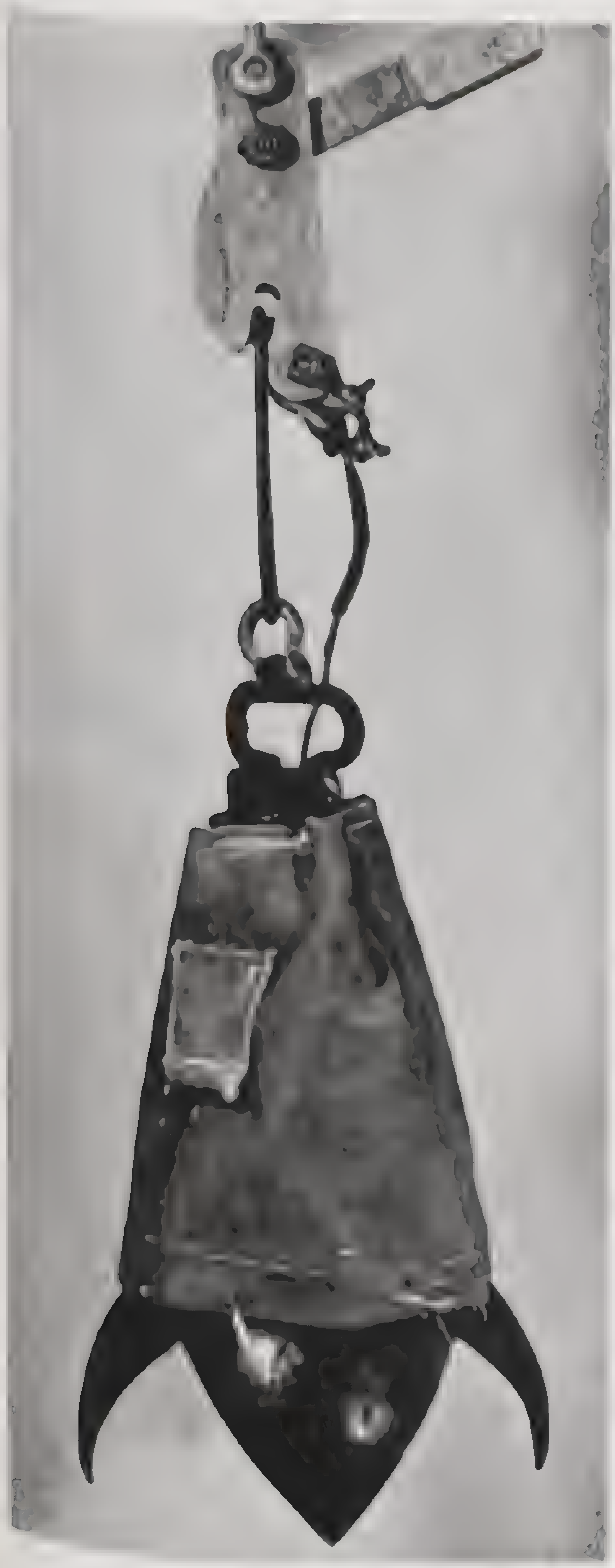


Figure 1. Orange-peel dredge

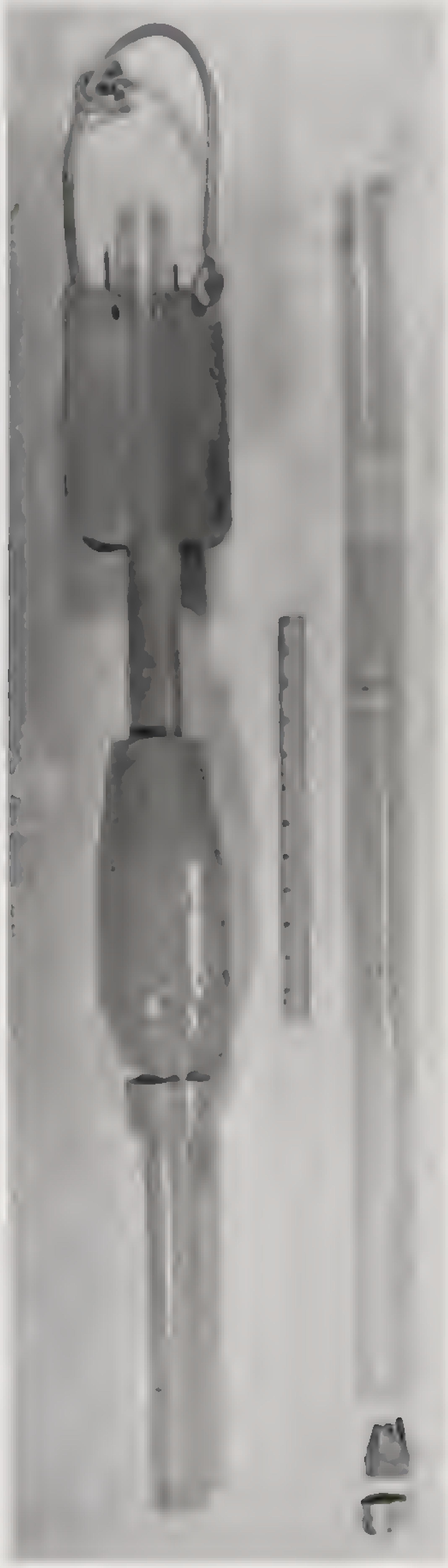


Figure 2. Short coring tube

A small orange-peel dredge (Figure 1) was used where the bottom sediments contained pebbles larger than about 1 inch in diameter. This dredge has a rated capacity of 100 cubic inches and obtains a large sample. It is fitted with a canvas hood to prevent washing of the sample enroute to the surface. The hood is attached to the upper edge of the jaws of the dredge by brass cotter pins through small holes drilled in the dredge. The upper surface of the hood is tied with a heavy draw string. Two water ports are cut in the hood to aid circulation of water through the dredge as it is lowered; these are covered with weighted canvas flaps to prevent undue water circulation and agitation of the sediment as the sampler is brought to the surface. A tripping device enables the dredge to be used from a single wire, as shown in Figure 1. This is hooked to a long, single link and the wire rope which operates the drum closing the dredge jaws is attached to the frame of the tripping device. The hook remains in the link while

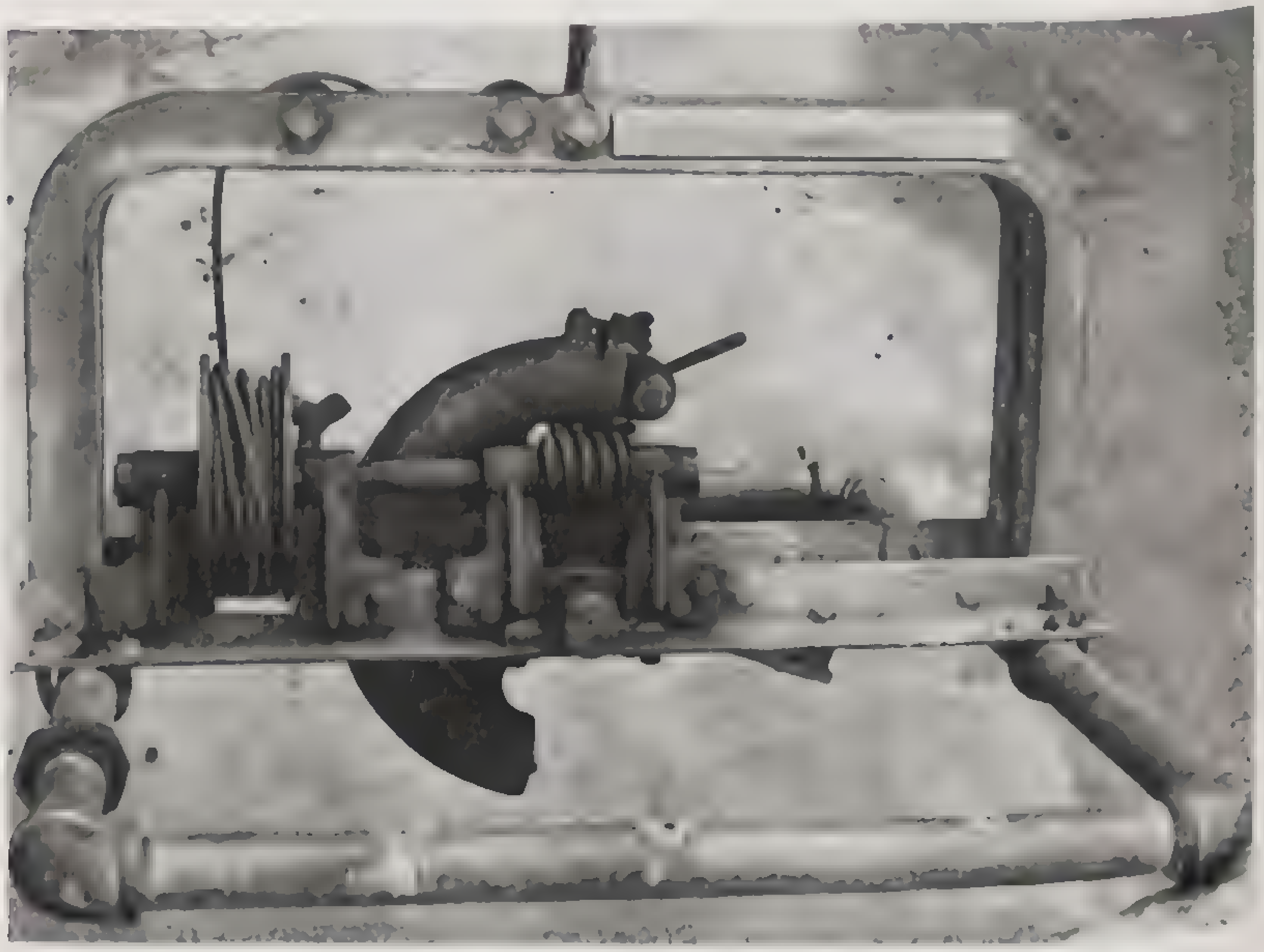


Figure 3. Stetson-Iselin sampler. The curved brass tube is forced into the sediment by action of the worm gear as the wire is hauled off the drum. Washing of the sample is prevented by sealing the open end of the tube against a rubber pad and closing the valve at the opposite end on the last turn. The sediment is extracted by slipping the axle and removing the curved tube from the frame of the sampler.

there is tension on the hoisting cable. When the sampler rests on the bottom and the hoisting wire becomes slack, the hook is disengaged from the link by fall of the weighted arm to which it is attached. As the wire is hoisted, tension is on the wire operating the jaw-closing mechanism and jaws are closed.

The small orange-peel dredge was used with success in this area down to depths of 150 meters or more. It occasionally falls on its side on the bottom but this generally can be avoided by lowering it slowly. There is some washing of the surface of the sediment sample after the dredge is taken from the water but this can be minimized by letting the water drain off the sediment with the jaws closed. A representative sample was taken from the surface of the sediment obtained. Small boulders occasionally were obtained with the orange-peel dredge.

The Stetson-Iselin sampler (Stetson, 1938) was used in areas of clean sand (Figure 3). The sample taken with this instrument is in a curved brass tube 2 inches in diameter. The sample is sealed into the brass tube and cannot be washed enroute to the surface. It is believed that this gear obtains a more representative sample of sand than any other yet in operation. It should not be used where there are pebbles approaching the diameter of the brass tube.

The Phleger sampler (Figure 2) was used in sediment consisting of mud or mud and sand. This is a small coring device consisting of a steel tube provided with a lead weight and tail fins. The steel tube contains a thin plastic liner of 1⅜ inches inner diameter in which the sediment is caught as the sampler plunges into the bottom. A spring-brass core-catcher aids in preventing loss of the core as the tube is extracted from the bottom and hauled in. Cores usually are up to 40 cm. long and each sample is retained in the plastic tube which serves as its permanent container. This gear obtains a relatively undisturbed sample of the surface sediment together with the sea water from directly above the bottom. Neutral formaldehyde was placed in the water in the plastic tube to make approximately a 5 per cent concentration; the purpose of this is to preserve the living Foraminifera fauna.

Laboratory Analysis

The total population of Foraminifera was determined in 318 samples of the surface of the bottom sediment. The living population of Foraminifera in the upper centimeter of sediment was determined in 213 of these samples. The vertical distribution of faunas was determined in 18 of the short cores, and the fauna of the bottom samples was analyzed from 38 of the short cores. All samples chosen for study of Foraminifera are so distributed that a representative survey is obtained of the whole area.

Faunas studied from the top of the short cores consisted of the upper centimeter of sediment. This material had been preserved in a solution of sea water and formaldehyde. The sediment was washed over a brass sieve having openings of .074 mm. The washed material was placed in a petri dish with additional tap water. The presence of specimens which contained protoplasm, and hence were presumed to be alive at the time the samples were collected, was determined by the use of Millon's reagent. Millon's reagent is made by dissolving one part by weight of mercury in two parts of concentrated nitric acid and diluting with twice its volume of water. The precipitate which forms is allowed to settle to the bottom and the supernatant liquid is used. A few drops of this reagent added to a solution and heated will cause protein to be colored bright red.

Millon's reagent contains free nitric acid and thus cannot be used on a sample containing calcareous Foraminifera. Samples examined for living specimens were almost exclusively composed of arenaceous species which are not affected by acid. Each sample was examined for calcareous Foraminifera before adding the reagent and the specimens discovered were recorded. There were only occasional calcareous specimens in a few samples. Several drops of Millon's reagent were added to the solution and the sample was warmed for 4 to 6 hours by the heat of a 75 watt incandescent lamp in a desk stand. It was generally desirable to break each arenaceous specimen to determine whether the presence of protoplasm was indicated by the characteristic red color. The number of specimens and the living population of each species were recorded. These are converted into percentage of the total living population for purposes of tabulation.

The amount of sediment collected by the Stetson-Iselin sampler and by the orange-peel dredge was rather large. An attempt was made to select an amount of material from each of these samples approximately equal to the amount taken from the surface of the undisturbed short cores.

The vertical distribution of Foraminifera in the short cores was determined from adjacent samples comprising a half section of the core. Each core sample was approximately 3 to 5 cm. long, except where a change in appearance of the sediment made more frequent sampling appear desirable. Each sample was trimmed on all sides to avoid contamination from adjacent parts of the core.

Distribution of each of the more abundant species in the area is plotted in Figures 7 to 25. The distribution is indicated in these figures in percentage groups as follows: less than 1, 1 to 5, 5 to 15, 15 to 25, 25 to 50, and more than 50 per cent. The actual percentage of all species in each sample is listed in Tables 2 to 7. Descriptions and illustrations of the species are in the accompanying paper by Parker.

SEDIMENT DISTRIBUTION

A brief description of the distribution of principal areas of the sediments is included here because of the apparent relationship with the distribution of many Foraminifera species. A generalized chart of sediment distribution is shown in Figure 4. This chart is based upon sediment mechanical analyses made principally by David B. Erikson and is published here in preliminary form. It is anticipated that a more comprehensive analysis of sediment distribution in the area will be contained in a future report.

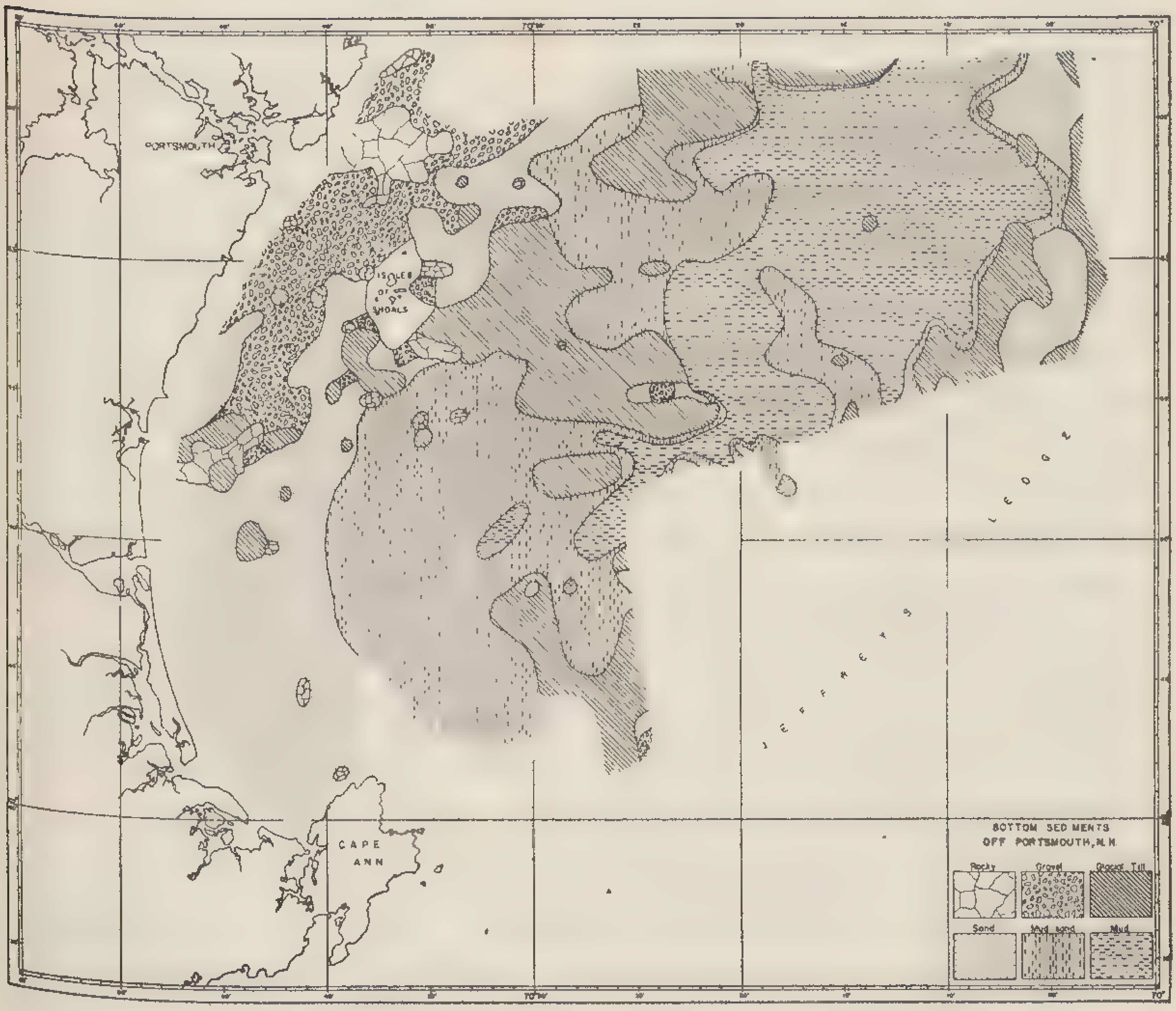

PORTSMOUTH
ISLES OF SHOALS
CAPE ANN
JEFFREYS LEDGE
BOTTOM SEDIMENTS OFF PORTSMOUTH, N.H.
Rocky
Gravel
Glacial Till
Sand
Mud sand
Mud
70°W
70°

Figure 4. Distribution of sediments

The nearshore zone from Cape Ann to north of the Merrimack River contains clean, well-sorted sand. In the north there is a large area of gravel or stony bottom, with some patches of rock, grading seaward into sand. There are two principal mud and sand areas in the central part of the area below depths of about 150 feet. These mud and sand areas are separated by an area of glacial till extending in a northwest-southeast direction. The sediment in the Portsmouth basin is a fine-grained mud. The part of Jeffreys Ledge investigated has two distinct sand areas surrounded by glacial till and mud and sand patches. There are several additional patches of glacial till at various places. Additional information about sediment distribution can be obtained from Figure 4.

DISTRIBUTION OF TEMPERATURE AND SALINITY

The temperature distribution in the Portsmouth area is relatively uniform for the area as a whole, although there are small local variations. The large seasonal variations are approximately similar throughout the area, so that the geographic temperature distribution is quite uniform. The vertical temperature structure at any one place gives a good picture of the structure at all other places of equal water depth. This area has water temperatures which are similar to those of the rest of the Gulf of Maine. They are thus significantly lower than the temperatures of coastal waters south of Cape Cod, especially during the summer and early autumn. There is no apparent effect from the warm waters of the Gulf Stream system due principally to topographic barriers, and also probably due to the presence of colder northern water masses. Most of the summer heat of the Gulf of Maine probably is produced by solar warming *in situ* and is of local origin according to Bigelow (1924, p. 699).

Salinity distribution in the Portsmouth area also is relatively uniform except for a slight decrease in salinity shoreward and in the Portsmouth basin where there is somewhat more saline bottom water than upper water. In the nearshore area effluents of less saline surface water occur off the mouths of the Merrimack and Piscataqua Rivers during times of flood, usually during the spring season and occasionally in the autumn season. This surface water of low salinity is mixed with the lower, more saline water during times of strong wind and may produce somewhat less saline water at the bottom in the shoal coastal areas. There is a coastal current flowing in a southerly direction according to Bigelow (1924, p. 974). This may tend to accumulate surface waters of low salinity, having their origin from the Merrimack River, between the Merrimack and Cape Ann.

Temperature and salinity data used are from the files of the Woods Hole Oceanographic Institution and were furnished by D. F. Bumpus. Many of the data were collected by C. R. Hayes and W. G. Metcalf. The following is a brief summary of the seasonal temperature and salinity distribution given in terms of mean monthly conditions. Mean monthly temperatures are generalizations which tend to obscure daily and other irregularities; actual extreme temperature ranges, for example, are always larger than mean monthly temperatures indicate.

Minimum surface temperatures occur during February when the monthly mean varies from a minimum of about 2° C. near the shore to 4° C. offshore. The water is essentially isothermal to the bottom even in the deepest part of the Portsmouth basin. These temperatures persist through March, there is a little surface warming during April, and by May the surface temperatures have reached approximately 8 to 9° C. A surface thermocline has developed in the upper 30 or 40 m. and the bottom temperatures average about 4.5°C., except in very shoal nearshore areas. Maximum surface temperatures are reached by August, when they average about 15.5 to 17°C. There is a strong thermocline in the upper 40 to 50 m. of water and bottom temperatures in the deepest part of the area are about 5.5° C. Essentially this condition obtains through September, marked cooling occurs during October, and by November the surface temperatures are 9 to 10° C. with either a very weak thermocline developed or essentially isothermal water to the bottom of the deepest part of the area. There is then progressive cooling and mixing at least through February.

Salinities during the winter months are rather uniform in geographic and bathymetric distribution at $32^{0}/_{00}$ to $32.5^{0}/_{00}$. By April the nearshore surface salinities are reduced to about $30^{0}/_{00}$, the offshore surface water is about $32^{0}/_{00}$ and there is a slight increase of salinity with depth to a maximum of $32.5^{0}/_{00}$ at the bottom of the Portsmouth basin. During the late spring and early summer minimum surface salinities of about $29^{0}/_{00}$ are reached in the southwest nearshore area between Cape Ann and the Merrimack River. There is a gradual increase in surface salinity until a nearshore average minimum of about $31.5^{0}/_{00}$ is reached in October with the deeper bottom water remaining at about $32.5^{0}/_{00}$. By November the water is essentially isohaline to the bottom at $32^{0}/_{00}$ to $32.5^{0}/_{00}$. Bottom water salinities of $33^{0}/_{00}$ have been recorded from the Portsmouth basin during December.

DISTRIBUTION OF MODERN FORAMINIFERA

Species Distribution

The modern distribution of each species found in the Portsmouth area is summarized in this section. In this area there is a close correlation between the distribution of most of the species and the type of sediment on which it is found. Distribution of the species is described in terms of the areas of different sediment type, as shown on Figure 5; this is a matter of convenience only and is not intended to imply an ecologic interpretation. Species are listed in alphabetical order. For further information consult Figures 7 to 25 and Tables 2 to 7.

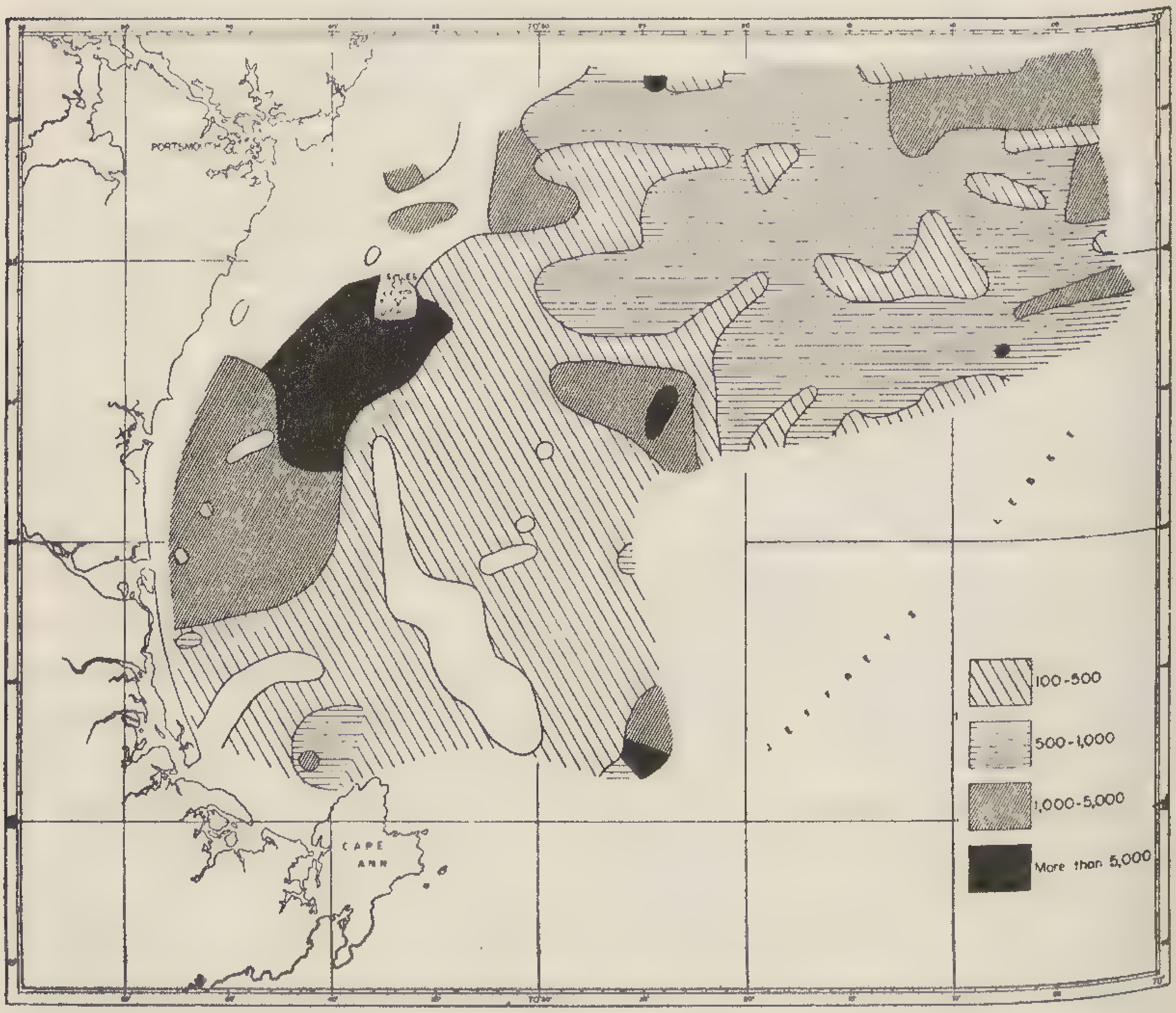


Figure 5. Distribution of total population of Foraminifera in actual numbers of specimens per uniform size sample

BENTHONIC FAUNA

Ammobaculites cassis (Parker) occurs at 12 widely separated stations in frequencies of 1 per cent or less. It is present on most sediment types.

Ammodiscus is present in low frequency in most of the samples from the area. It is always less than 5 per cent of the fauna, and usually less than 1 per cent.

Angulogerina angulosa (Williamson) is present at only a few stations in sand areas. Almost all the occurrences are less than 1 per cent and none are greater than 2 per cent.

Astrononion stellatum Cushman and Edwards is confined to a few stations on sand bottom and has a usual frequency of less than 1 per cent and always less than 5 per cent.

Bolivina pseudoplicata Heron-Allen and Earland is present at 10 nearshore sand stations with an average frequency of less than 1 per cent.

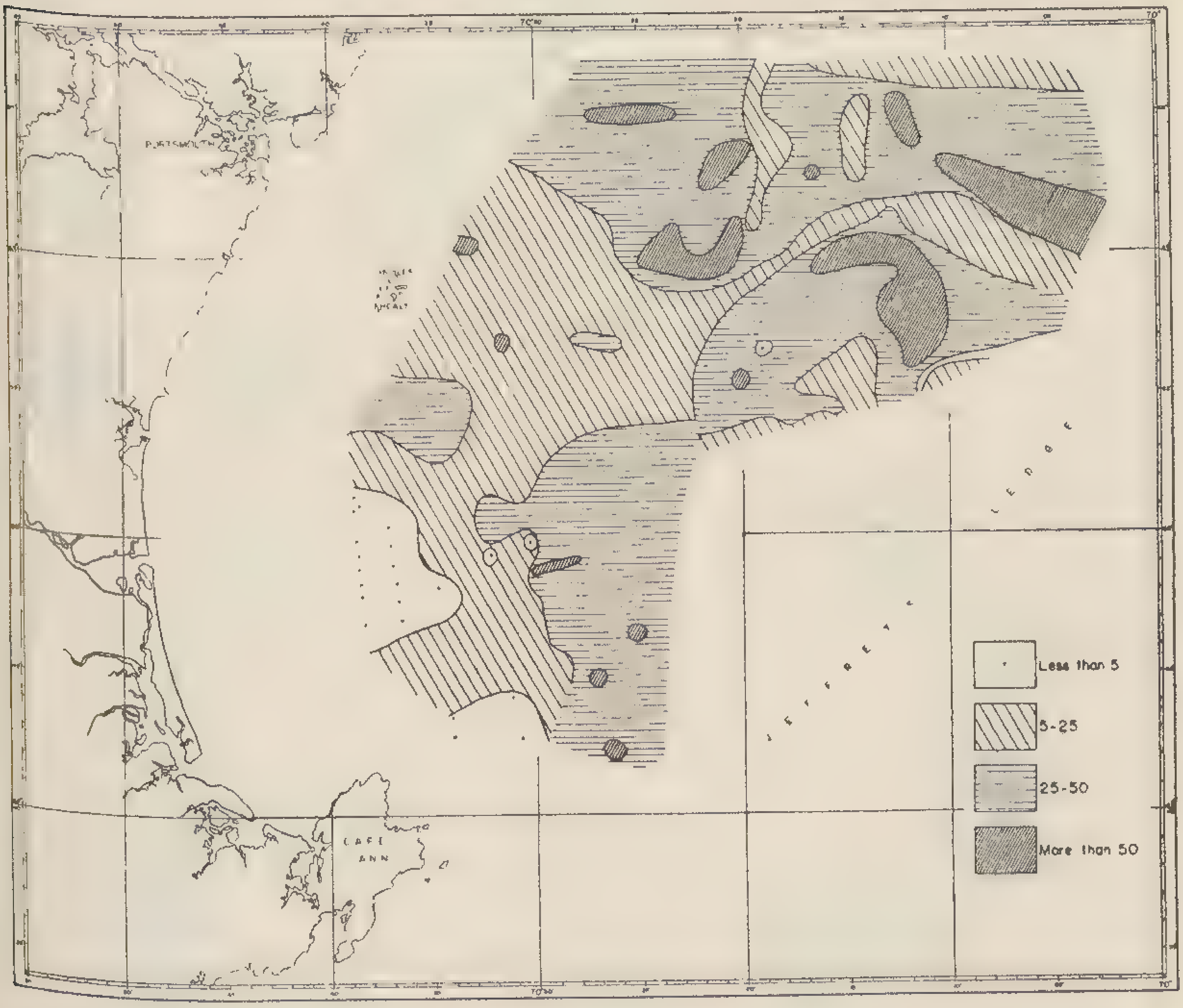


Figure 6. Distribution of living population of Foraminifera in number of specimens per uniform area

Bolivina pseudopunctata Höglund is found at 2 nearshore stations and at 2 stations on a small sand patch in the south-central part of the area. It is less than 1 per cent of the fauna at these stations.

Bolivina subaenariensis Cushman is 0.2 per cent of the fauna at a station in the southeast offshore sand area.

Bulimina aculeata d'Orbigny occurs at 9 widely separated stations on various sand areas with a maximum frequency of 2 per cent.

Buliminella elegantissima (d'Orbigny) is present in 6 widely separated samples from nearshore sand areas at less than 1 per cent of the fauna.

Cassidulina algida Cushman is characteristic of the sand areas and occurs on some of the mud-sand bordering the two eastern sand areas. It reaches its highest frequency in the northeastern section where it occurs as 79 per cent of the fauna at Station 271 and 70 per cent at Station 645.

Cassidulina norcrossi Cushman is less than 1 per cent at 3 stations in the south-central part of the area and is 12 per cent of the fauna at Station 355 and 7 per cent at Station 50.

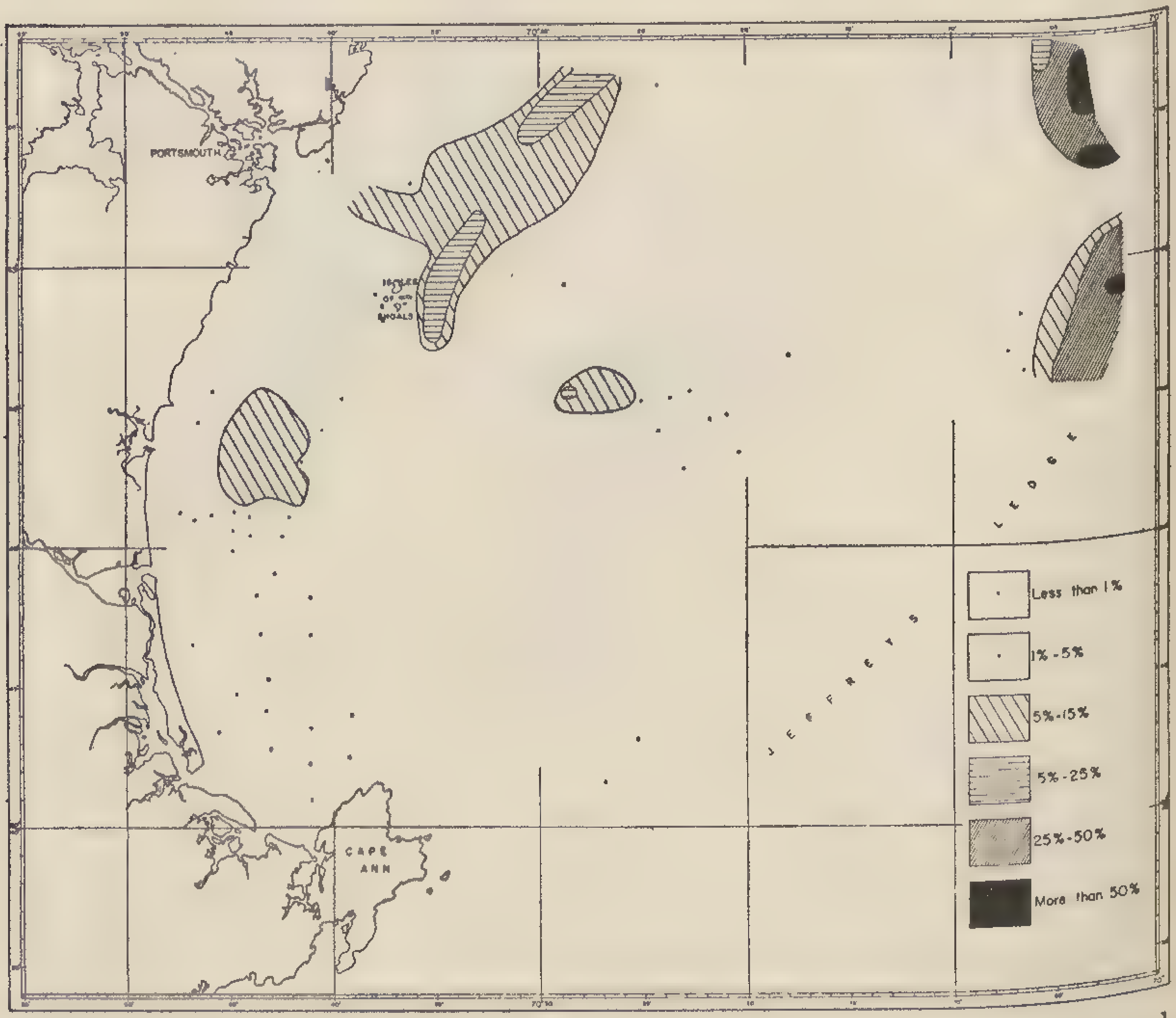


Figure 7. Distribution of *Cassidulina algida* Cushman in per cent of total population of benthonic Foraminifera

Cibicides lobatulus (Walker and Jacob) is characteristic of the sand areas. It reaches its highest percentage north of the Isles of Shoals, where it constitutes 50 to 90 per cent of the fauna, and off Hampton Beach (up to 85 per cent). It is not present in the mud and mud-sand areas.

Crithionina pisum Göes var. *hispida* Flint is present in very low frequency at 4 stations in the Portsmouth basin and at 1 station in the southwest mud-sand area.

Discorbis columbiensis Cushman is found at 18 stations mostly from the southwest, inshore sand area and principally off Hampton Beach. One occurrence is from the northeast sand area and one is from a glacial till patch in the central part of the area. It is usually 1 per cent or less of the fauna but at 2 stations it is more than 5 per cent.

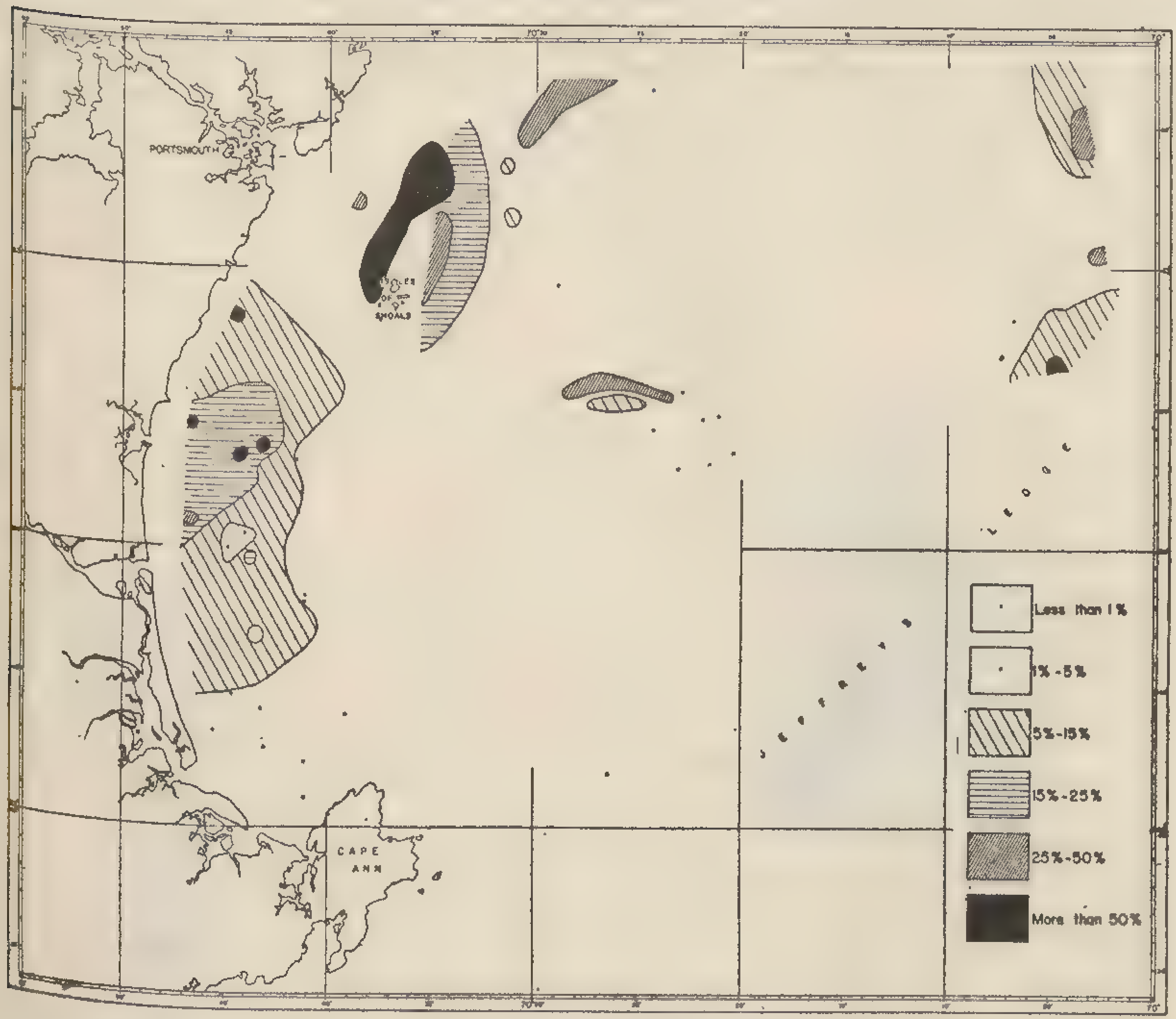


Figure 8. Distribution of *Cibicides lobatulus* (Walker and Jacob) in per cent of total population of benthonic Foraminifera

Discorbis squamata Parker is known from 4 stations on the inshore sand area off the Merrimack River and from 1 station off the Piscataqua River. The frequency varies up to 2 or 3 per cent.

Eggerella advena (Cushman) has its greatest abundance in the southwest sand area where in the southern part of this area the species averages more than 50 per cent of the fauna. There is a regular increase shoreward from the boundary between the mud-sand and the sand. There are two other patches of relatively high frequency, on the seaward side of the Isles of Shoals and in the small northwest sand area. This species occurs at numerous other stations throughout the Portsmouth area but usually is less than 1 per cent of the fauna.

Elphidium articulatum (d'Orbigny) is present in low frequency, usually less than 5 per cent, on the inshore sand and gravel areas and at a few stations on offshore sand areas. At Station 395 it is 14 per cent of the fauna.

Elphidium incertum (Williamson) var. *clavatum* Cushman is characteristic of inshore sand areas and does not occur on mud or mud-sand bottom. Its highest percentage appears to be at water depths less than about 30 meters. It is 48 per cent of the fauna at Station 406 off Plum Island and 31 per cent at Station 554 off Portsmouth.

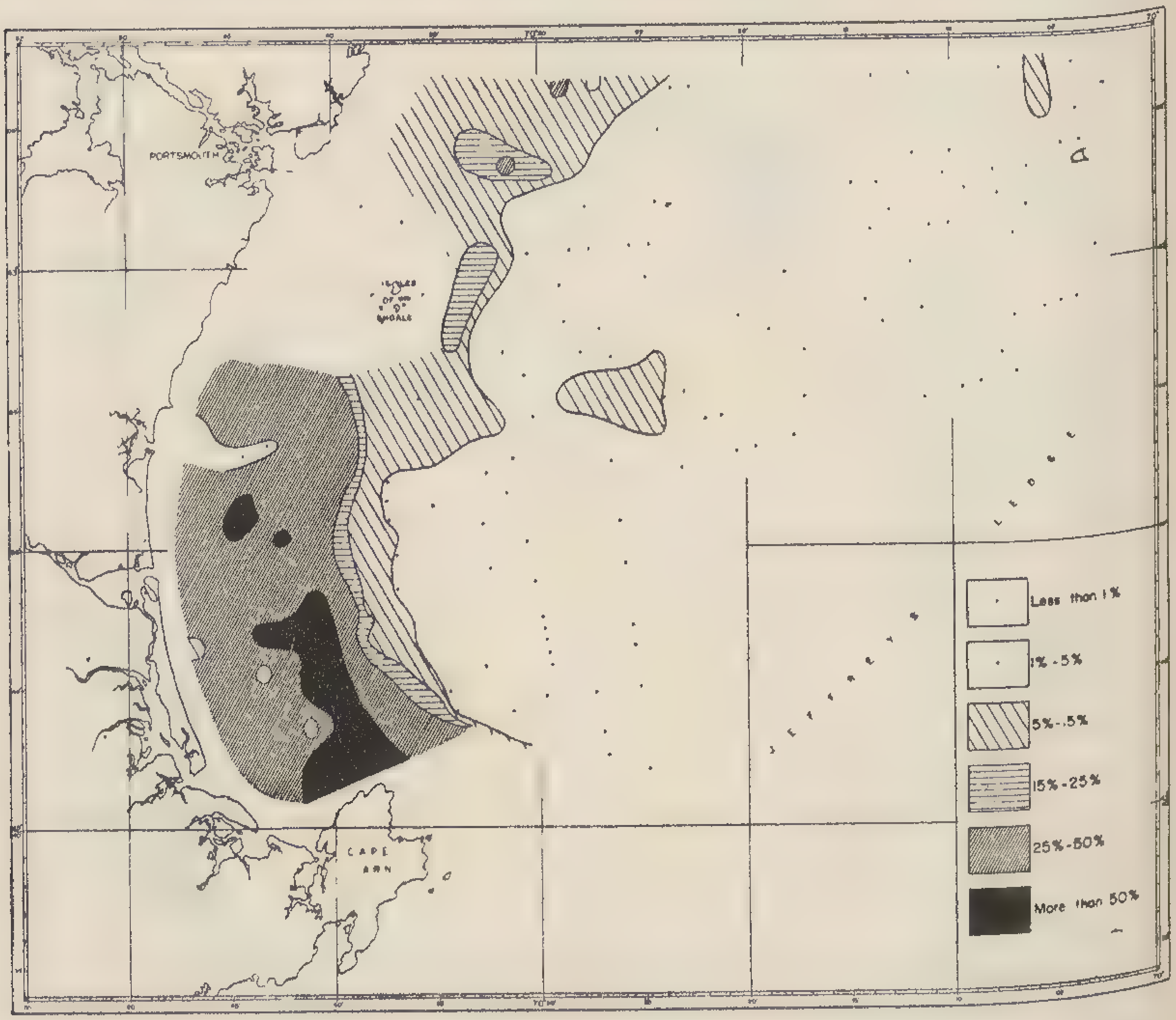


Figure 9. Distribution of *Eggerella advena* (Cushman) in per cent of total population of benthonic Foraminifera

Elphidium subarcticum Cushman is characteristic of the shoal water sand areas. It reaches the highest percentage in the southwest sand area where in the southern section it is 33 per cent of the fauna at Station 376. It does not occur on mud and mud-sand areas.

Eponides frigidus (Cushman) appears to be largely confined to the sand areas. The greatest frequency occurs in a rather large patch east and north of the mouth of the Merrimack River where it averages 8 to 10 per cent of the fauna. It also occurs in the northwest, the south-central, and the two eastern sand areas.

Eponides umbonatus (Reuss) constitutes 0.1 per cent of the fauna at Station 395.

Eponides wrightii (H. B. Brady) is less than 1 per cent of the fauna at one station in the north-central part of the area.

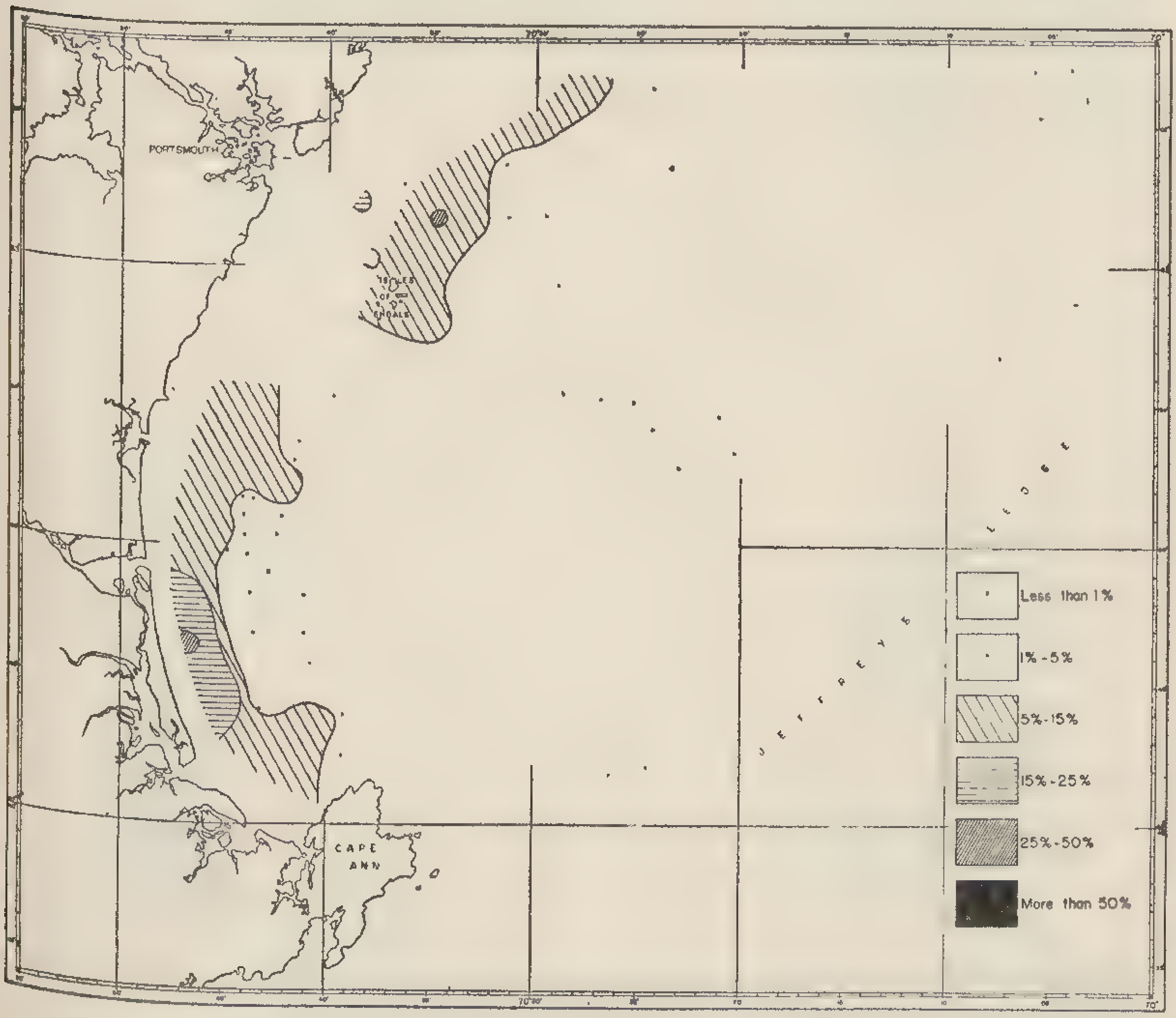


Figure 10. Distribution of *Elphidium incertum* (Williamson) var. *clavatum* Cushman in per cent of total population of benthonic Foraminifera

Globobulimina (*Desinobulimina*) *auriculata* (Bailey) is present at only a few stations and generally constitutes less than 1 per cent of the fauna except in the small sand patch in the south-central part of the area where the species attains a local maximum of 16 per cent.

Glomospira gordialis (Jones and Parker) occurs at numerous stations at frequencies usually less than 1 per cent and not greater than 2 per cent and is present on all types of sediment.

Haplophragmoides bradyi (Robertson) is essentially confined to the mud area in the Portsmouth basin where frequencies as high as 60 per cent occur. The center of greatest abundance is in the north-central part of the basin. It is present at only a few stations outside this area, usually less than 10 per cent of the fauna, and is not present in sand areas. All the living specimens found are from the Portsmouth basin but they occur at only approximately one-half of the stations. There appear to be centers of proliferation of living specimens with no living forms in between the centers.

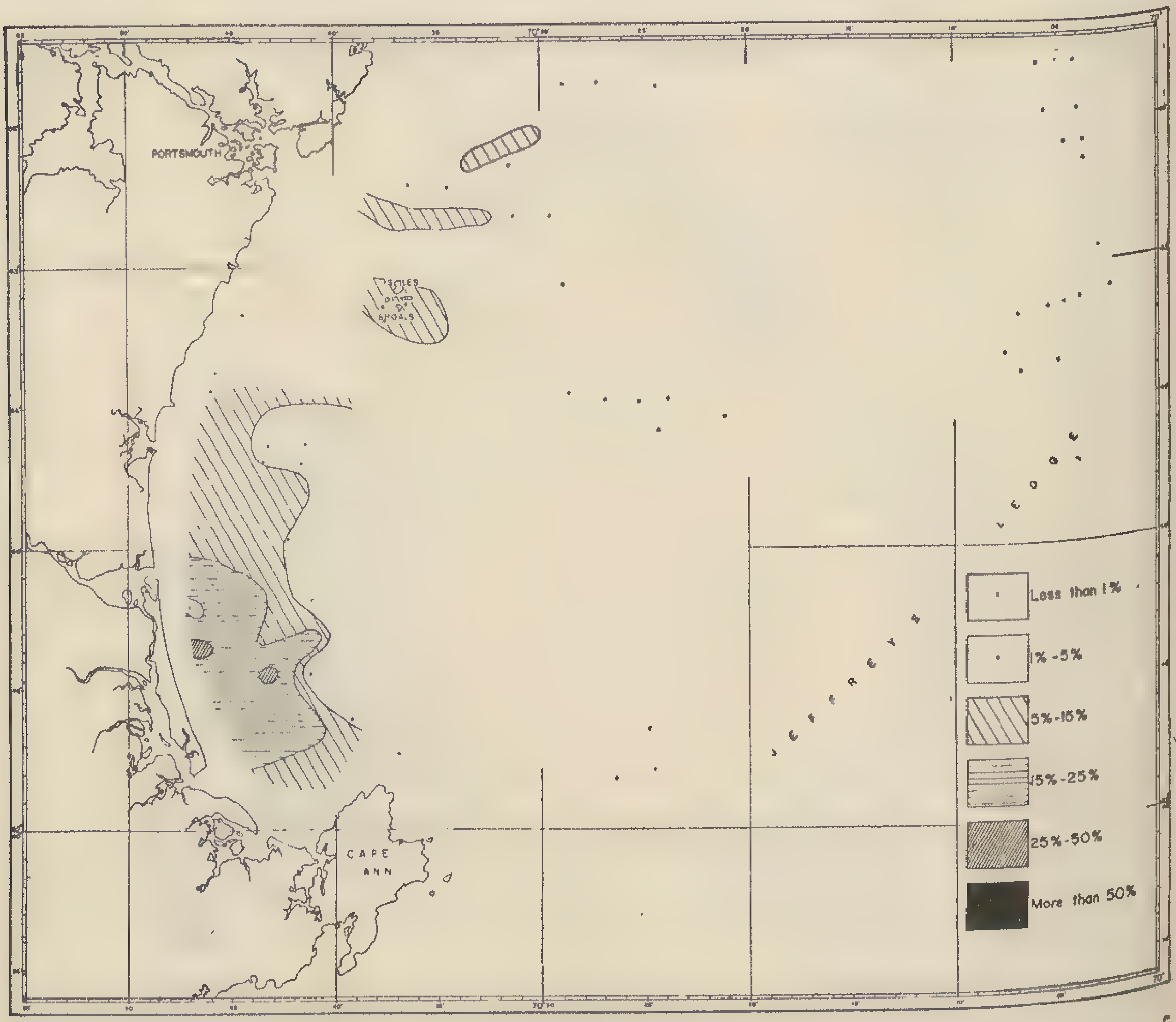


Figure 11. Distribution of *Elphidium subarcticum* Cushman in per cent of total population of benthonic Foraminifera

Haplophragmoides glomeratum (H. B. Brady) is widely distributed with generally high frequency in all parts of the area except on the nearshore sands and gravel and two sand areas on Jeffreys Ledge. Frequencies of more than 30 per cent are common. It occurs in only a few samples from the nearshore materials and usually is less than 1 per cent of the population in these samples.

Hippocrepina indivisa (Parker) is widely distributed at numerous stations, principally in mud and mud-sand areas, with frequencies less than 1 per cent. The greatest number of occurrences is in the southwest mud-sand area.

Hyperammina elongata H. B. Brady is less than 1 per cent of the fauna at numerous stations on all types of sediment except the inshore areas.

Labrospira crassimargo (Norman) is widely distributed in all samples in mud, mud-sand, and central glacial till areas, having an average frequency of 5 to 15 per cent. It also occurs in numerous sand samples but in very low percentage. This species attains its highest frequency in the southwest mud-sand area where it is as high as 80 per cent.

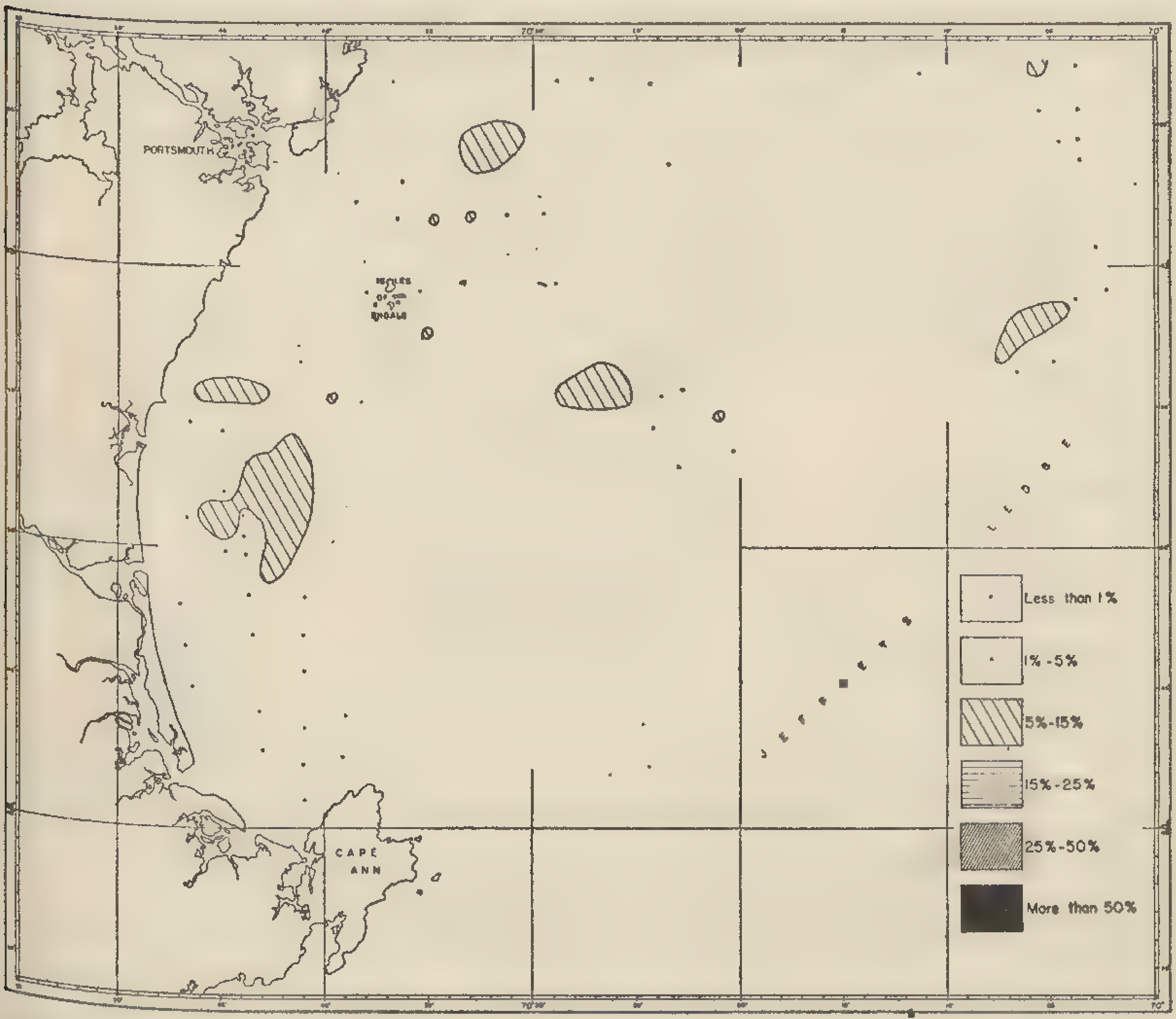


Figure 12. Distribution of *Eponides frigidus* (Cushman) in per cent of total population of benthonic Foraminifera

Labrospira jeffreysii (Williamson) is widely distributed and generally less than 5 per cent of the fauna but has a higher frequency in the mud and mud-sand areas. It does not occur in inshore sand areas. There is an area of high concentration on the eastern end of the mud-sand area and a marked decrease in frequency shoreward from here.

Labrospira cf. *nitida* (Göes) constitutes less than 1 per cent of the fauna at 12 stations in the Portsmouth basin.

Miliammina fusca (H. B. Brady) is found at 7 stations in the nearshore, southwest sand area. All occurrences are from off the mouth of the Merrimack River and southward from there. It is less than 1 per cent at 6 stations and 2 per cent at 1 station.

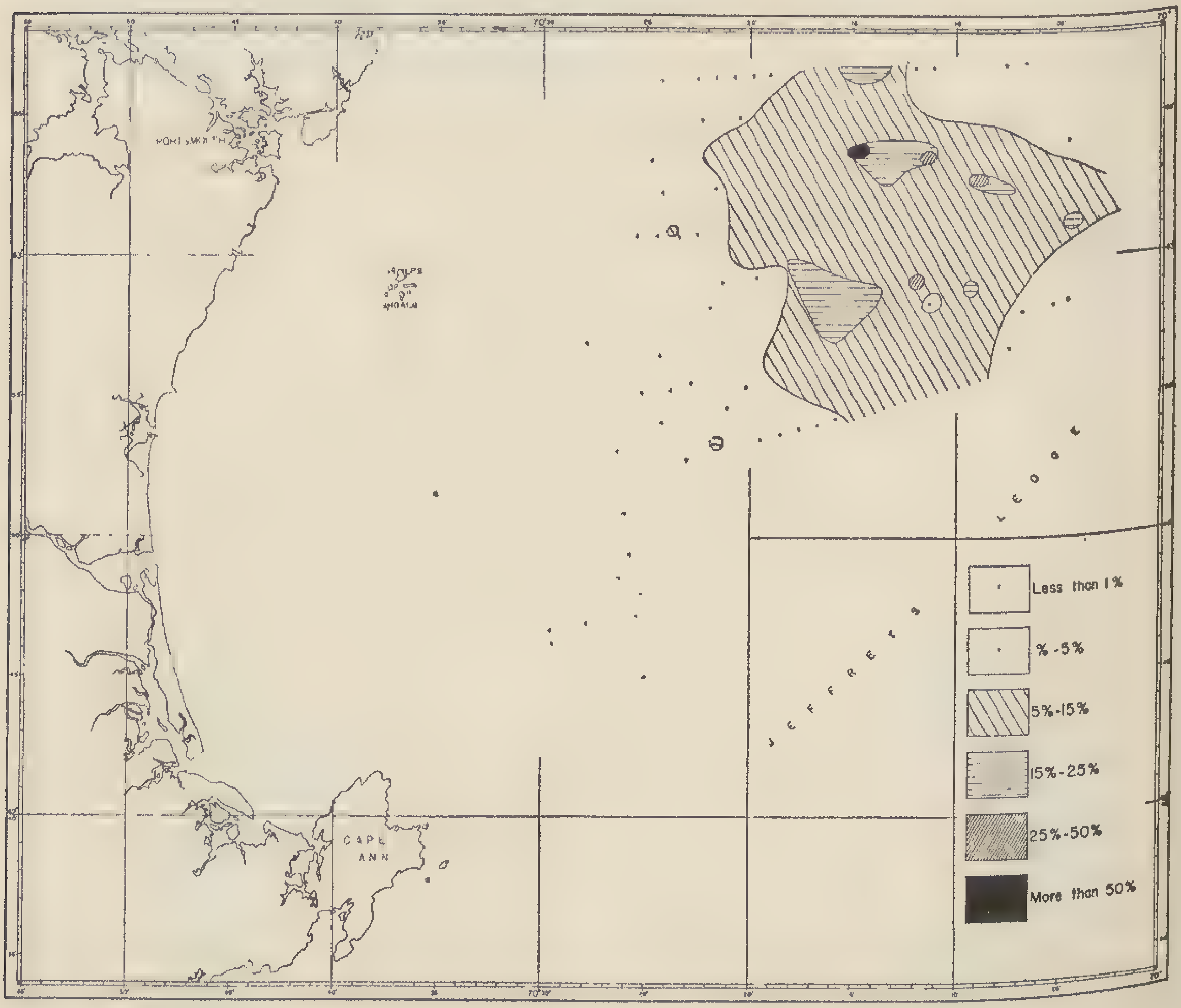


Figure 13. Distribution of *Haplophragmoides bradyi* (Robertson) in per cent of total population of benthonic Foraminifera

Nonion labradoricum (Dawson) is present at only 37 stations and usually with a very low frequency. It occurs at 5 stations in the southwest sand area where it has a frequency of less than 1 per cent, and at a few stations in the northwest sand and gravel areas. The highest frequency is in the glacial till east of the Isles of Shoals and in the small eastern sand areas where locally it has a concentration of 15 per cent or more.

Nonionella auricula Heron-Allen and Earland is present at Station 246 in the central part of the area where it is 0.4 per cent of the fauna.

Patellina corrugata Williamson constitutes less than 1 per cent of the fauna at 7 stations on inshore areas and at 1 station on an offshore sand area.

Proteonina atlantica Cushman is universally distributed throughout the area, constituting a relatively large percentage of almost every sample examined. The lowest frequency is in the north-central mud-sand area, in the inshore part of the southwest sand area, and in the central part of the Portsmouth basin. The distribution of the living population has the same general pattern as the distribution of the empty tests in the samples.

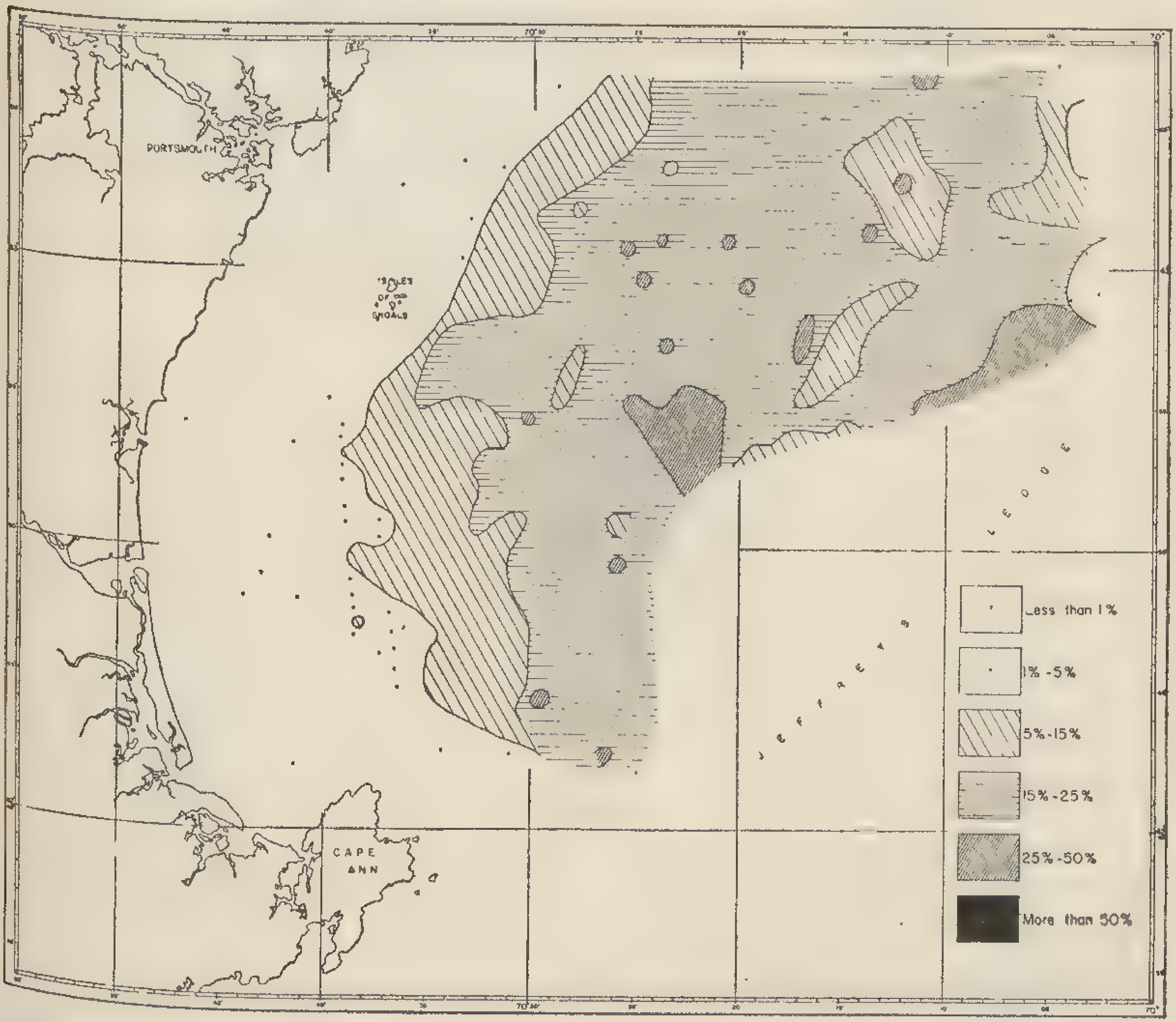


Figure 14. Distribution of *Haplophragmoides glomeratum* (H. B. Brady) in per cent of total population of benthonic Foraminifera

Pseudopolymorphina novangliae (Cushman) has frequencies less than 1 per cent at 9 stations in the inshore sand and gravel areas and at 1 station in the northeast sand patch.

Quinqueloculina arctica Cushman is present at 20 stations in the nearshore sand and gravel at frequencies less than 1 per cent. It was found only north of the mouth of the Merrimack River.

Quinqueloculina frigida Parker was found at 21 stations at frequencies less than 1 per cent, mostly on the nearshore areas. It is present at 5 stations on the southwest mud-sand area.

Quinqueloculina seminula (Linné) occurs at a few nearshore stations with frequencies less than 1 per cent. One occurrence is in the southeast offshore sand area and three occurrences are in the south-central sand patch.

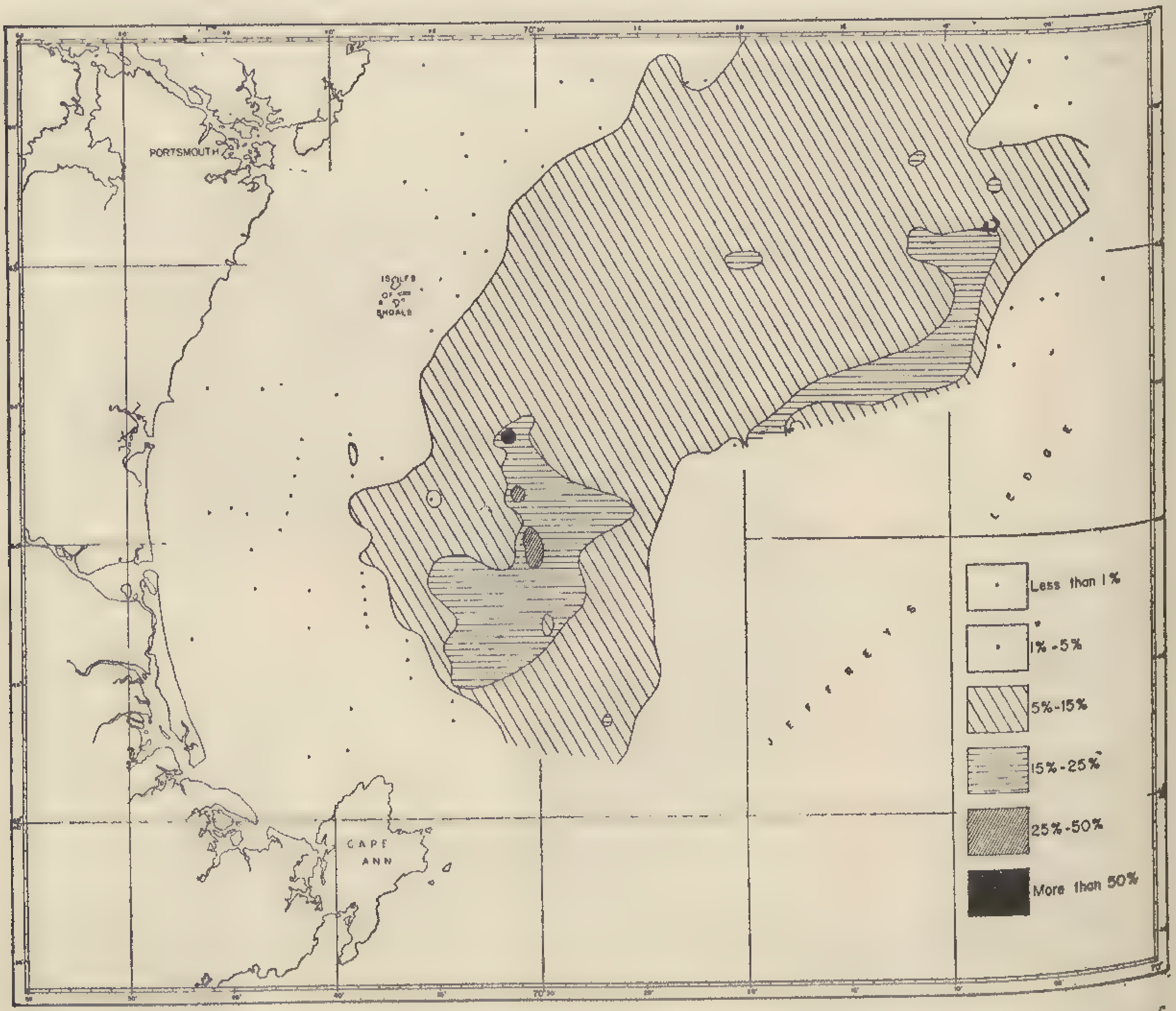


Figure 15. Distribution of *Labrospira crassimargo* (Norman) in per cent of total population of benthonic Foraminifera

Quinqueloculina subrotunda (Montagu) appears to be restricted to the nearshore areas where it is recorded from only a few stations and is usually less than 1 per cent of the fauna. At Station 707 it is 14 per cent of the fauna.

Recurvoides turbinatus (H. B. Brady) has the greatest frequency in the Portsmouth basin where it averages 5 to 15 per cent of the fauna and reaches a maximum of 26 per cent at one station. This species also occurs at most stations in the mud-sand areas, especially in the southwest mud-sand area. It is present at only a few sand stations and is always less than 1 per cent of the fauna where it occurs.

Reophax arctica H. B. Brady is rather widely distributed with the frequency generally less than 5 per cent and in approximately half the samples less than 1 per cent. The greatest concentration is on the inshore side of the southwest mud-sand area where locally it is more than 5 per cent.

Reophax curtus Cushman is a dominant member of the fauna in the mud and mud-sand areas. There are 3 large areas of high concentration, in the north-central mud-sand area and in the southern mud-sand area, and in the Portsmouth basin. In large parts of these areas the species averages more than 30 per cent of the fauna. In sand areas *R. curtus* is usually less than 1 per cent of the fauna at the few stations where it is found.

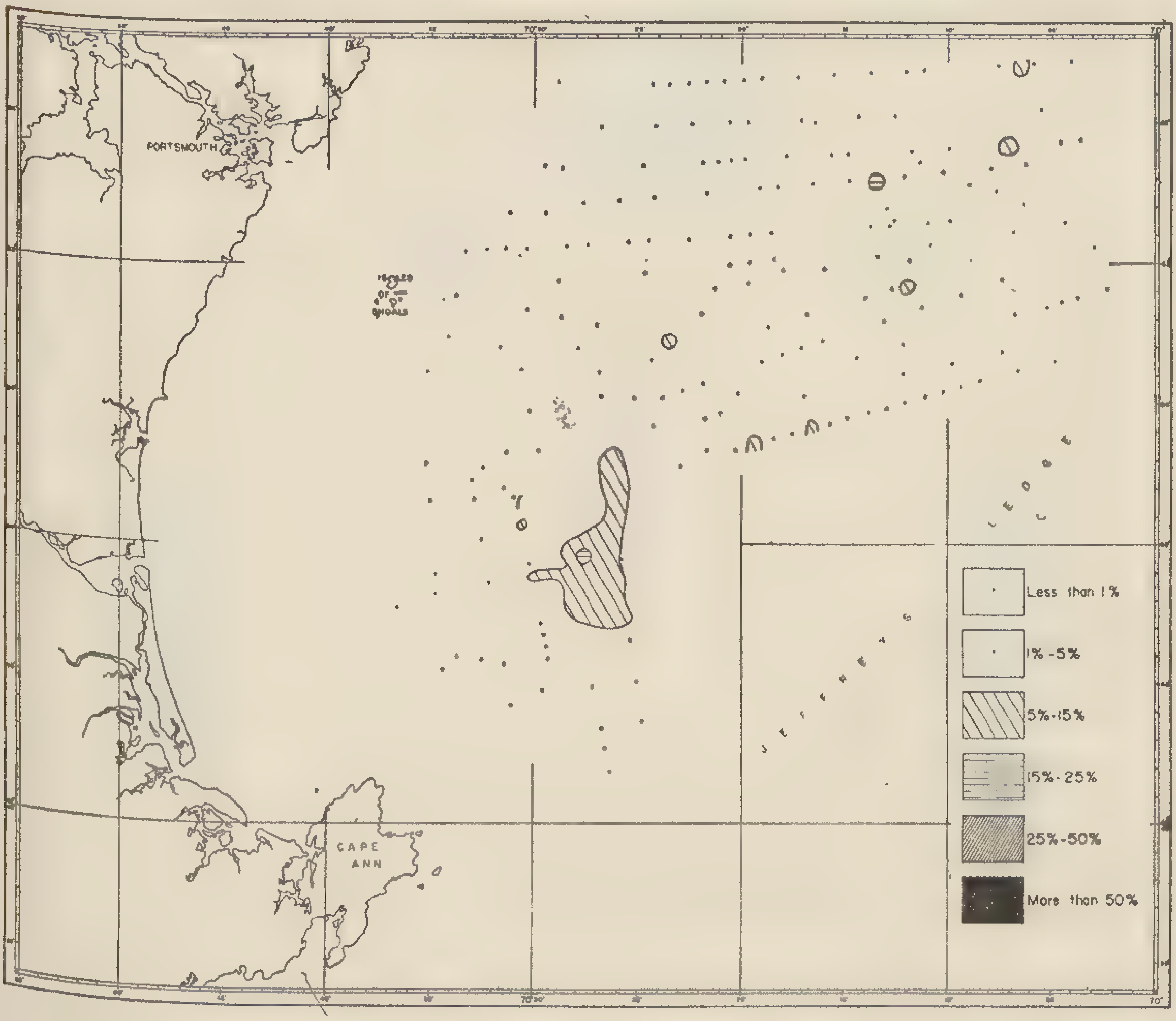


Figure 16. Distribution of *Labrospira jeffreysii* (Williamson) in per cent of total population of benthonic Foraminifera

Reophax scottii Chaster has a very discrete frequency distribution. The highest frequency is on the shoreward side of the southwest mud-sand area where a large patch has an average of 15 to 25 per cent of the species and 1 station has 64 per cent. There is also an area of relatively high frequency in the north-central mud-sand. This species is present at several other places on all types of sediment but in lower percentages.

Spiroplectammina biformis (Parker and Jones) appears to be characteristic of the mud-sand areas. There is a large area of relatively high frequency on the inshore side of the southwest mud-sand. The 5 per cent frequency boundary approximately coincides with the seaward limit of sand. Percentages are generally less on mud than on mud-sand.

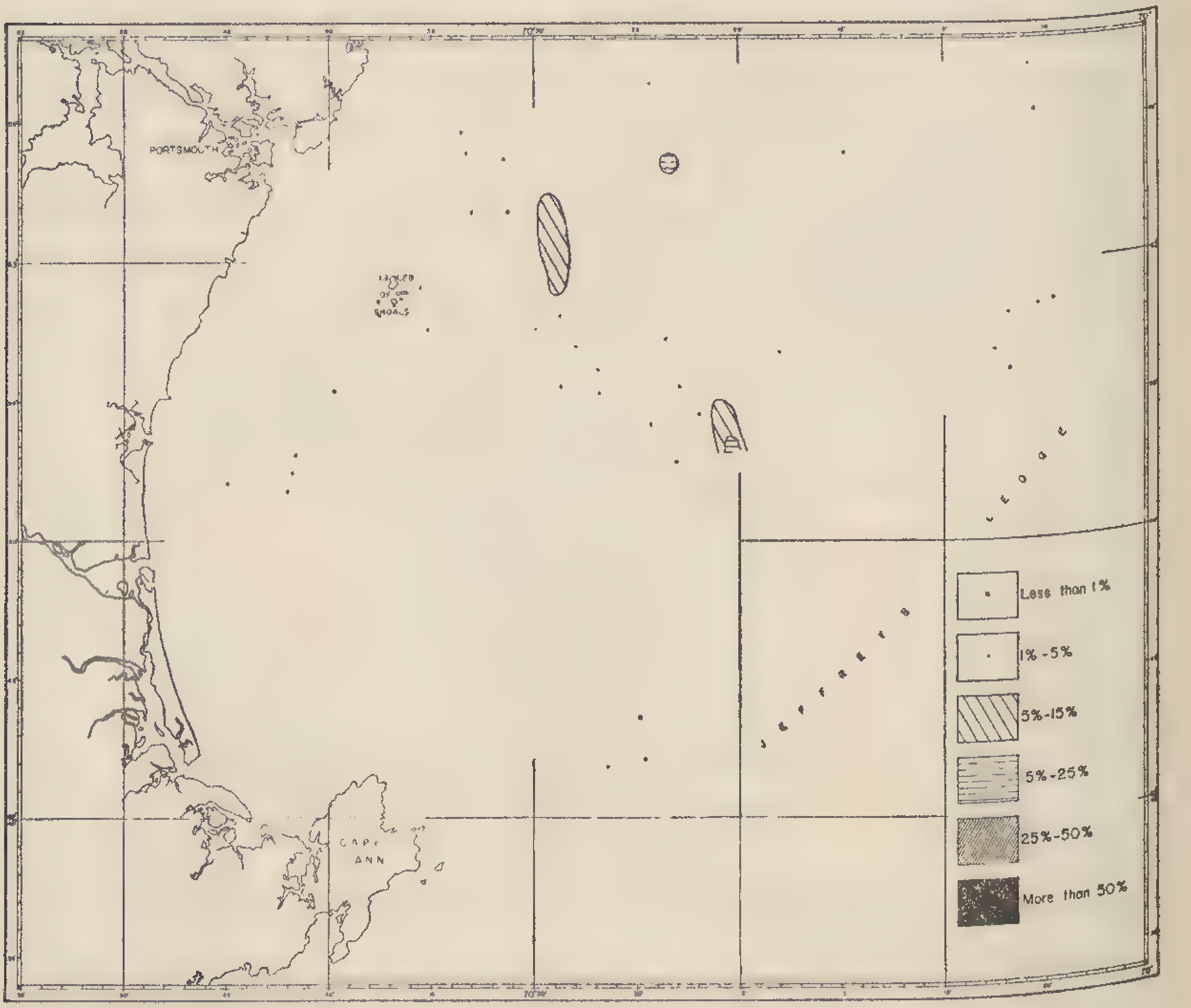


Figure 17. Distribution of *Nonion labradoricum* (Dawson) in per cent of total population of benthonic Foraminifera

Spiroplectammina typica Lacroix is present at numerous stations, widely distributed, and on all types of sediment. The frequency usually is less than 1 per cent but at 1 station it constitutes 4 per cent of the fauna.

Textularia torquata Parker is most abundant on the mud-sand areas and in the central glacial till area where the frequency averages 5–15 per cent or more. The largest area of high frequency (15–25 per cent) is in the southwest mud-sand area. This species is present at most stations in the Portsmouth basin with frequencies less than 5 per cent and also at several inshore sand stations with frequencies of 1 per cent or less.

Triloculina tricarinata d'Orbigny was recorded from one station in each of the following: the southwest sand, the northeast sand, and the southeast sand area. It is 0.2 per cent of the fauna at each station.

Trochammina advena Cushman is present at most stations in the Portsmouth basin with average frequencies less than 1 per cent and none greater than 3 per cent.

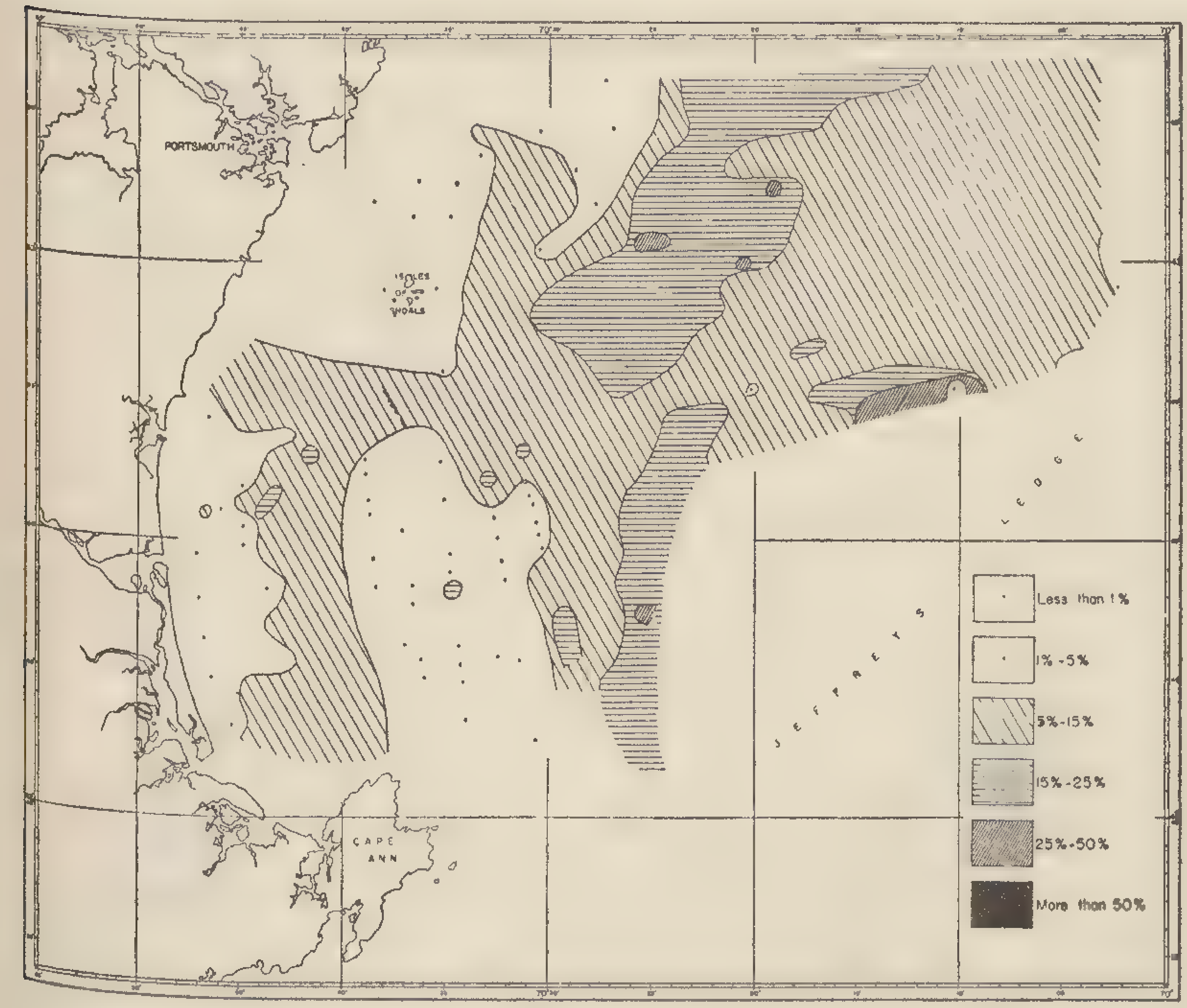


Figure 18. Distribution of *Proteonina atlantica* Cushman in per cent of total population of benthonic Foraminifera

Trochammina inflata (Montagu) is found at 6 stations in the southwest sand area, 5 of which are south of the Merrimack River. One occurrence is off the mouth of the Piscataqua River, and 1 occurrence is recorded from the edge of the Portsmouth basin. Frequencies range up to 4 per cent south of the Merrimack River.

Trochammina lobata Cushman occurs at several of the nearshore sand stations and also at a few of the offshore sand stations, with the greatest number of occurrences in the southwest sand area. Frequencies are up to 5 per cent in the latter area.

Trochammina macrescens H. B. Brady is reported from 1 station off the mouth of the Merrimack River where it is 0.1 per cent of the fauna.

Trochammina quadriloba Höglund was found at numerous stations in the Portsmouth basin where it has a frequency usually less than 1 per cent but as high as 2 per cent. It is essentially restricted to the Portsmouth basin but a few occurrences are recorded from nearby mud-sand areas.

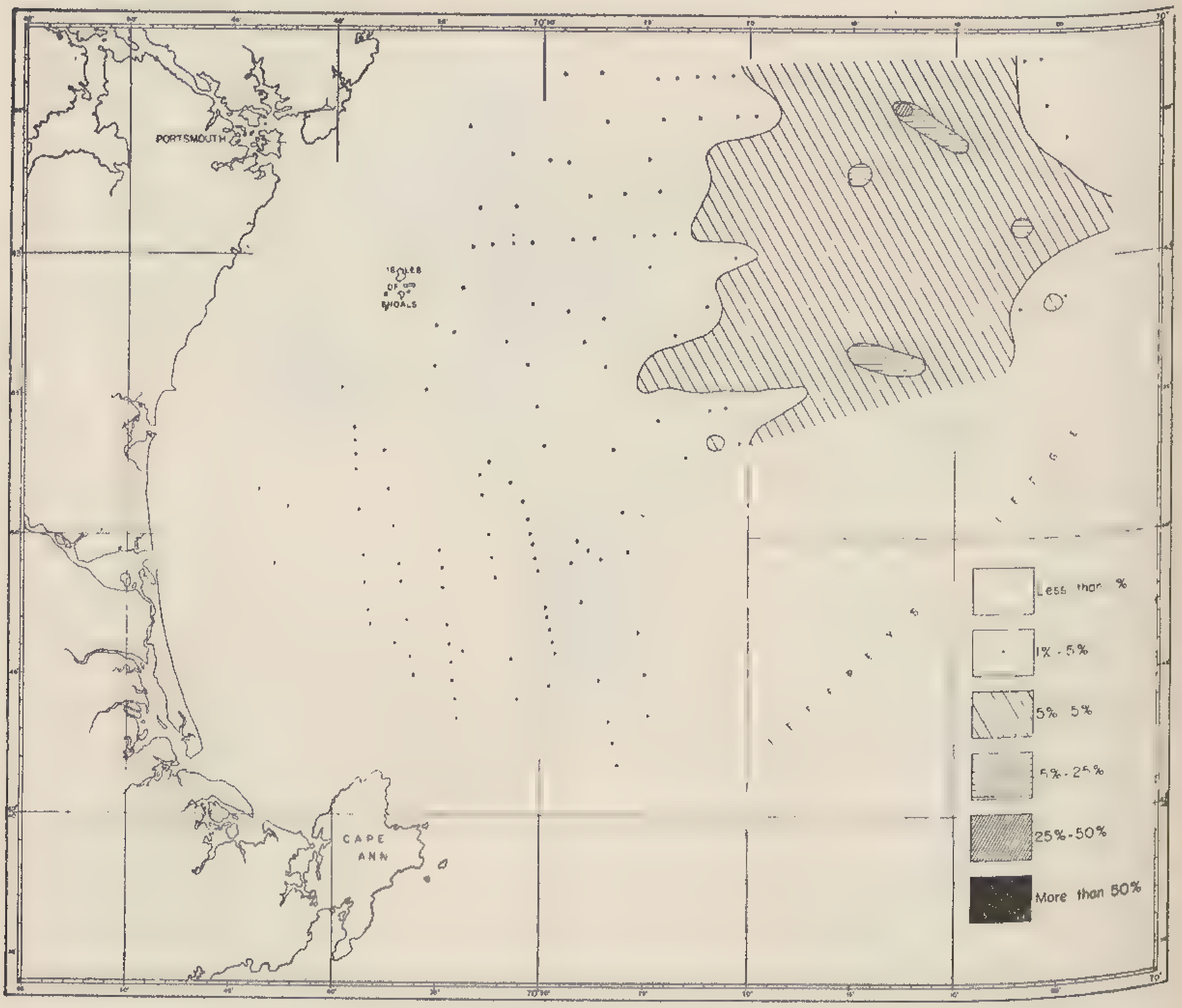


Figure 19. Distribution of *Recurvoides turbinatus* (H. B. Brady) in per cent of total population of benthonic Foraminifera

Trochammina squamata Parker and Jones is widespread on all types of bottom material, occurring at approximately three-fourths of the stations. The highest concentration is on the shoreward part of the southwest mud-sand area, where the shoreward boundary of high frequency approximately follows the boundary between sand and mud-sand. The frequency reaches 35 per cent in this area; elsewhere the frequency is low.

Valvulina conica Parker and Jones was found at several stations mostly in the Portsmouth basin, but at a few stations elsewhere. The frequency is less than 1 per cent where it occurs.

Virgulina complanata Egger is recorded from 11 stations in off shore sand areas where it is 2 per cent or less of the fauna. It has not been discovered at any of the nearshore stations. This species appears to occur in small, but well-defined patches.

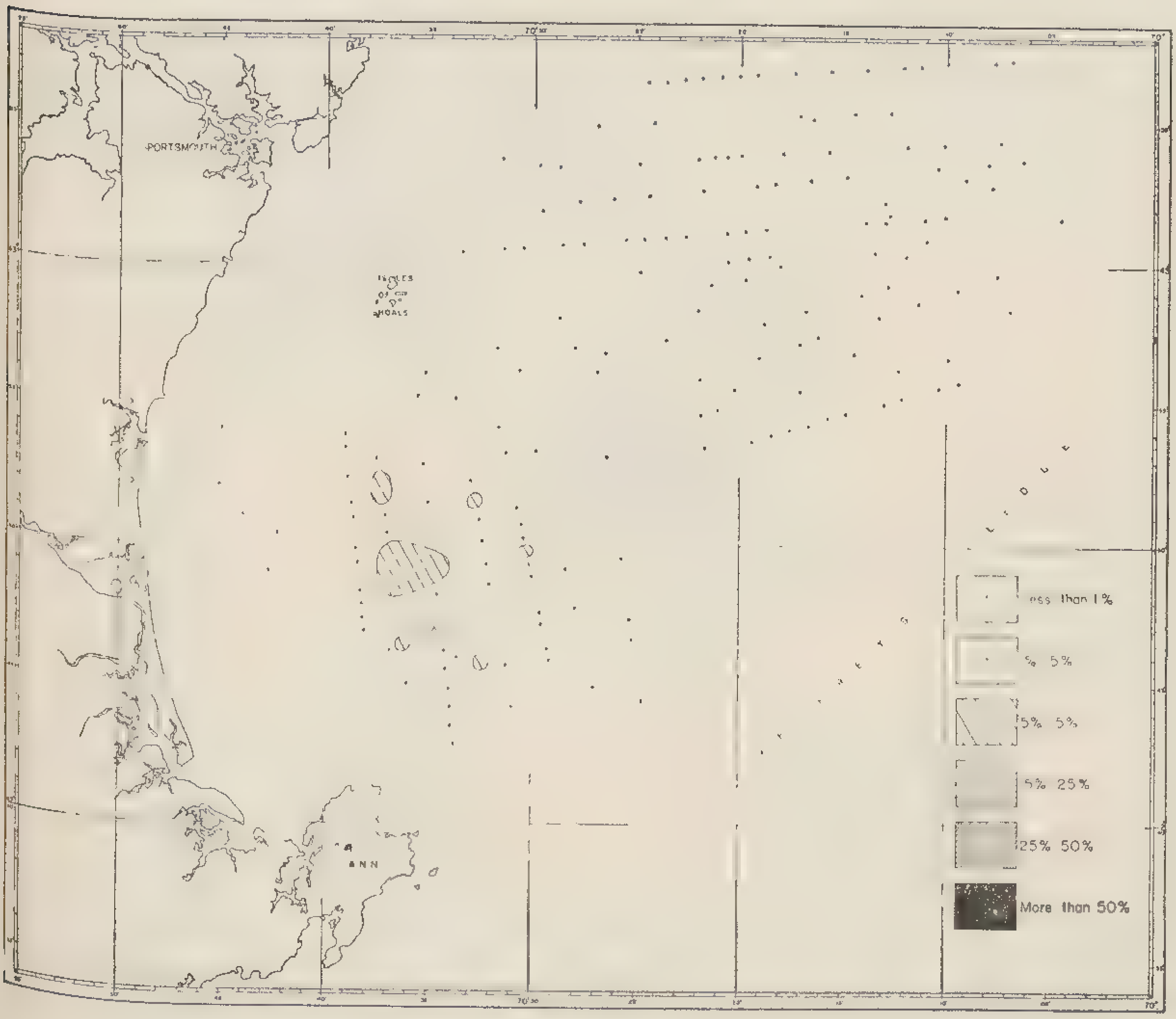


Figure 20. Distribution of *Reophax arctica* H. B. Brady in per cent of total population of benthonic Foraminifera

Virgulina fusiformis (Williamson) occurs at only a few stations with a frequency usually less than 5 per cent. It appears to be confined to sand bottom.

PLANKTONIC FAUNA

Planktonic Foraminifera were discovered in surface sediment samples at the following stations: 23, 50, 197, 224, 246, 356, 372, 404, 610, 614, 647, 685, and 736. Planktonic specimens constitute a very minor element of the fauna at these stations; 120 specimens were found at Station 224, in marked contrast to the abundance at most places. The specimens all belong to *Globigerina bulloides* d'Orbigny and *Globigerina* sp., except for one specimen of *Globigerinoides rubra* (d'Orbigny) at Station 50.

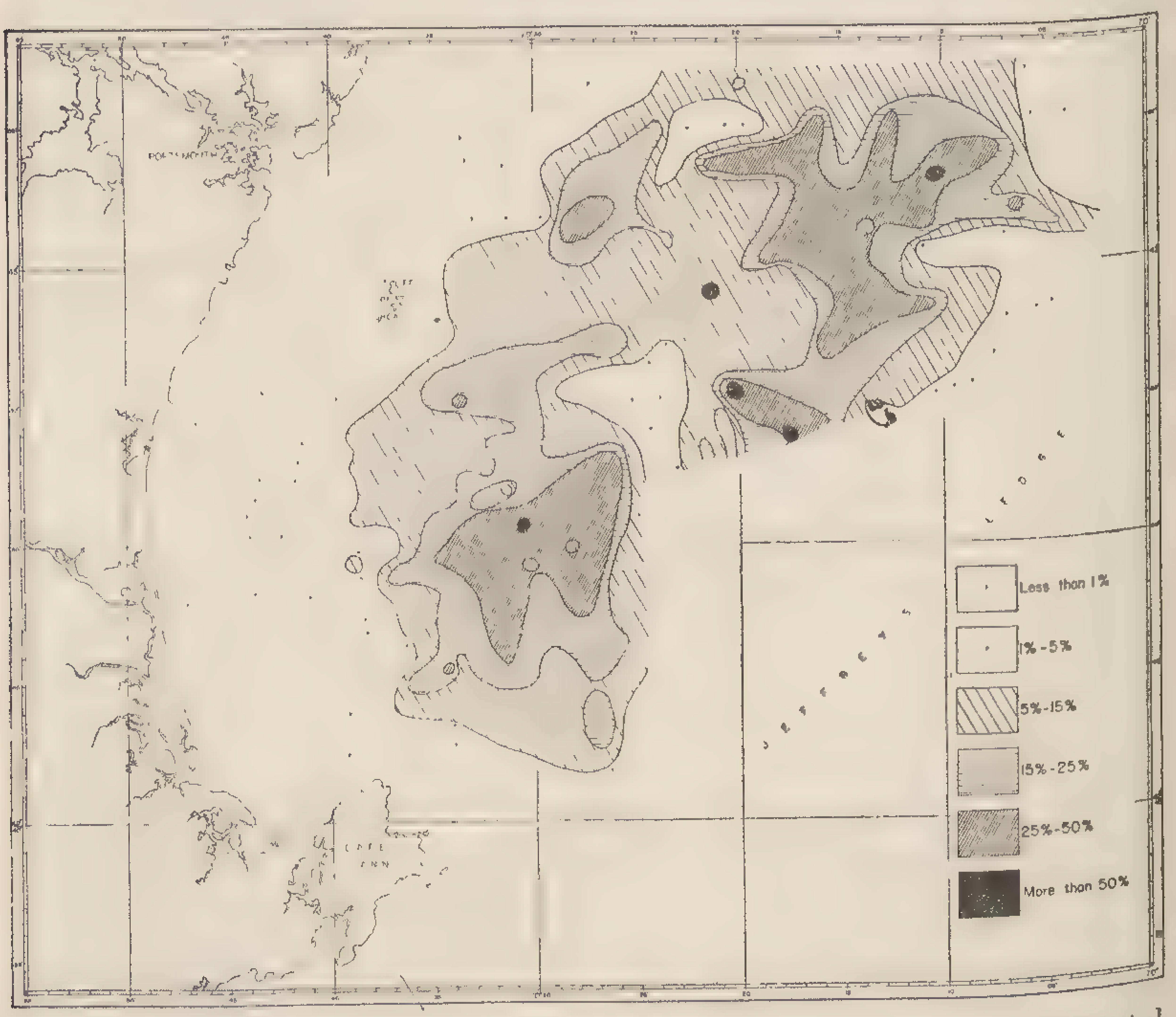


Figure 21. Distribution of *Reophax curtus* Cushman in per cent of total population of benthonic Foraminifera

Distribution of Living Fauna

The distribution of living Foraminifera was investigated in 213 samples. Study of living specimens was restricted to samples collected with the short coring tube, since these samples are the only ones which contain undisturbed sections of the surface of the sediment and in which specimens were preserved in formaldehyde. The short coring tube will only collect samples in sediment which contains sufficient mud to give it a certain amount of cohesiveness. The analysis of distribution of living populations in this area is restricted, therefore, to bottom sediments other than those of clean sand, gravel and rock.

The restricted distribution of samples for the living fauna should be kept in mind in evaluating the results.

All samples taken with the short coring tube cover an equal area of bottom and are approximately equal in size. Specimens were not examined alive but had been preserved in formaldehyde. The chemical color test used is one for the identification of protein. The use of this method for determining the presence of living specimens in this type of material involves the following assumptions: (1) that the presence of protein in the shell indicates the presence of protoplasm, and (2) the presence of protoplasm indicates that the specimen was either alive at the time it was collected or had been living only a short time previous to collection. It is believed that both these assumptions are valid.

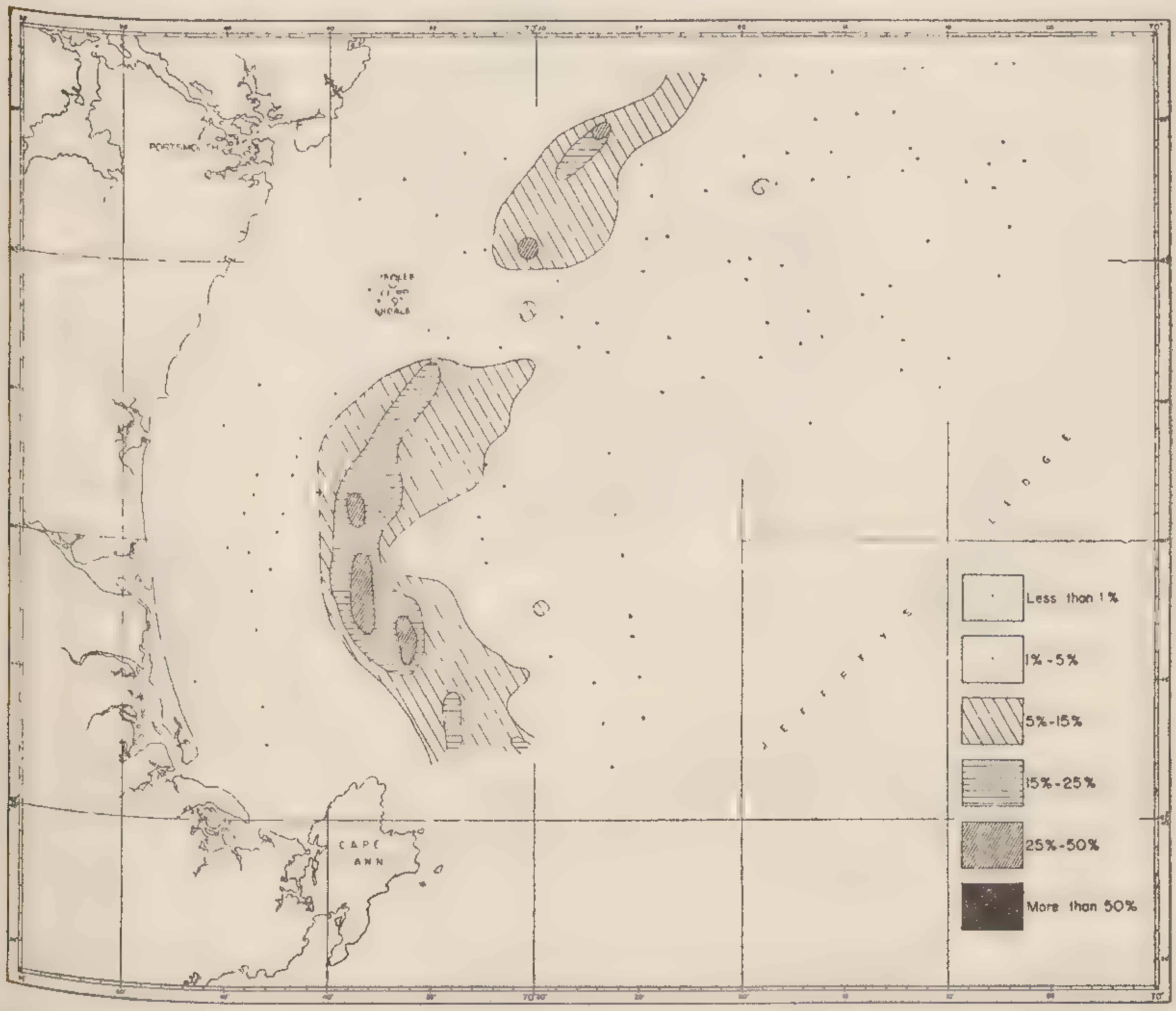


Figure 22. Distribution of *Reophax scottii* Chaster in per cent of total population of benthonic Foraminifera

Twenty-six species of Foraminifera were found living in the samples examined, or approximately 40 per cent of the total number of species reported from the bottom samples and all the species characteristic of mud and mud-sand areas. All the more common species were represented by living specimens except those species characteristic of the sand and gravel areas where no samples were collected for living specimens. The species found living are listed in Table 12 in decreasing order of abundance; the number of stations at which a species was found living is taken as a measure of its relative abundance in Table 12. Actual abundances in terms of percentage of total living population may be obtained from Tables 8 to 11.

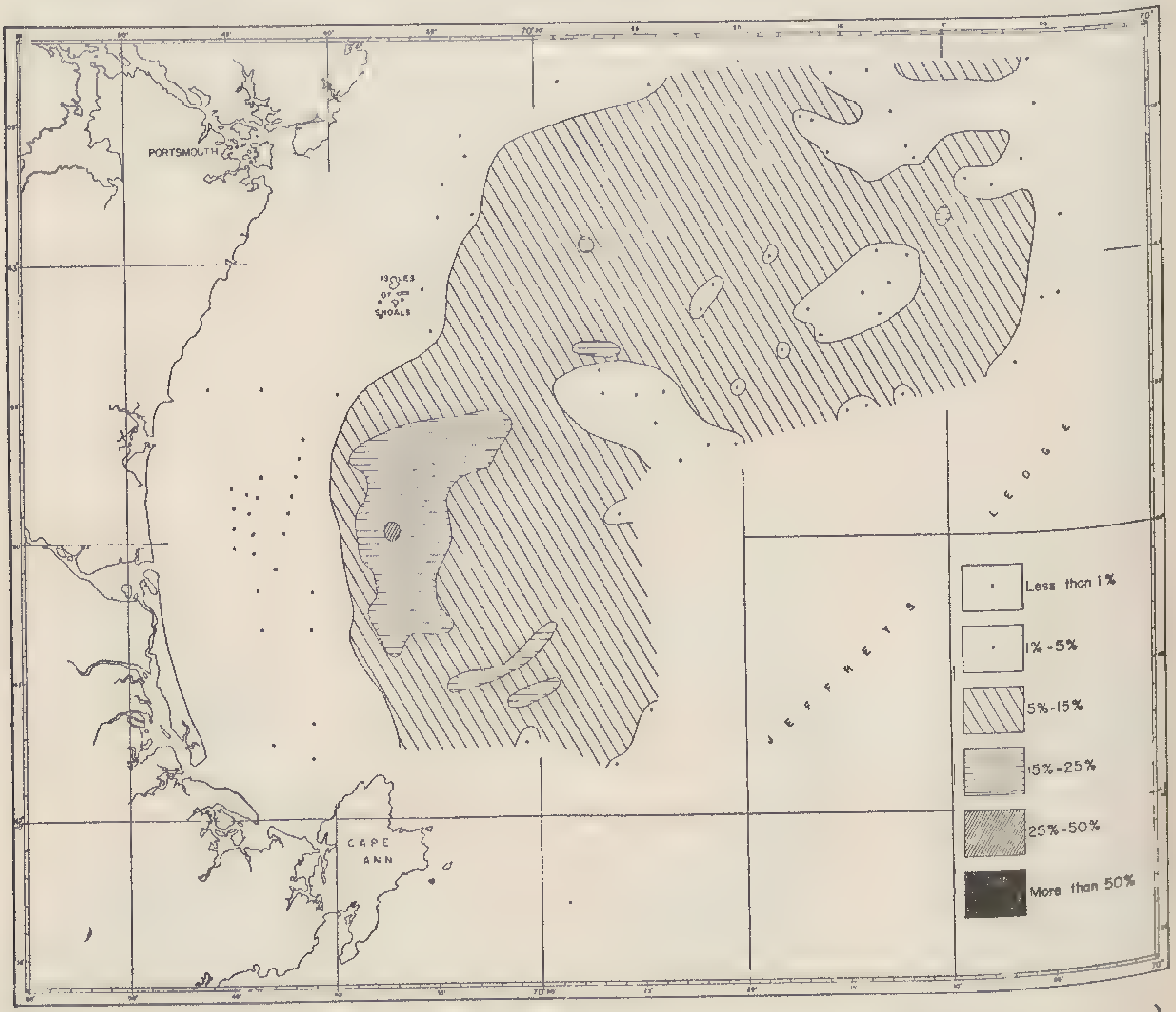


Figure 23. Distribution of *Spiroplectammina biformis* (Parker and Jones) in per cent of total population of benthonic Foraminifera

Frequencies of several of the most abundant living species have been plotted geographically, similar to the population plots in Figures 7 to 25. These unpublished plots show a good correlation between the distribution of the total population of each species and the distribution of the living representatives of that species. The areas of high concentration are the same for all species which have been analyzed. This is clearly seen in *Reophax arctica*, for example, where the only important abundance in total population is near the shoreward side of the southwest mud-sand area but it has a scattered low frequency elsewhere. Nine of the 14 occurrences of living specimens are grouped in the southwest mud-sand area and the remaining 5 occurrences are scattered. Both living and total populations of *Haplophragmoides bradyi* are essentially confined to the Portsmouth basin and none has been recorded from the southwest mud-sand area. The distribution chart of *Recurvoides turbinatus* shows an important concentration in the Portsmouth basin with scattered occurrences elsewhere; the living population of this species has the same geographic distribution.

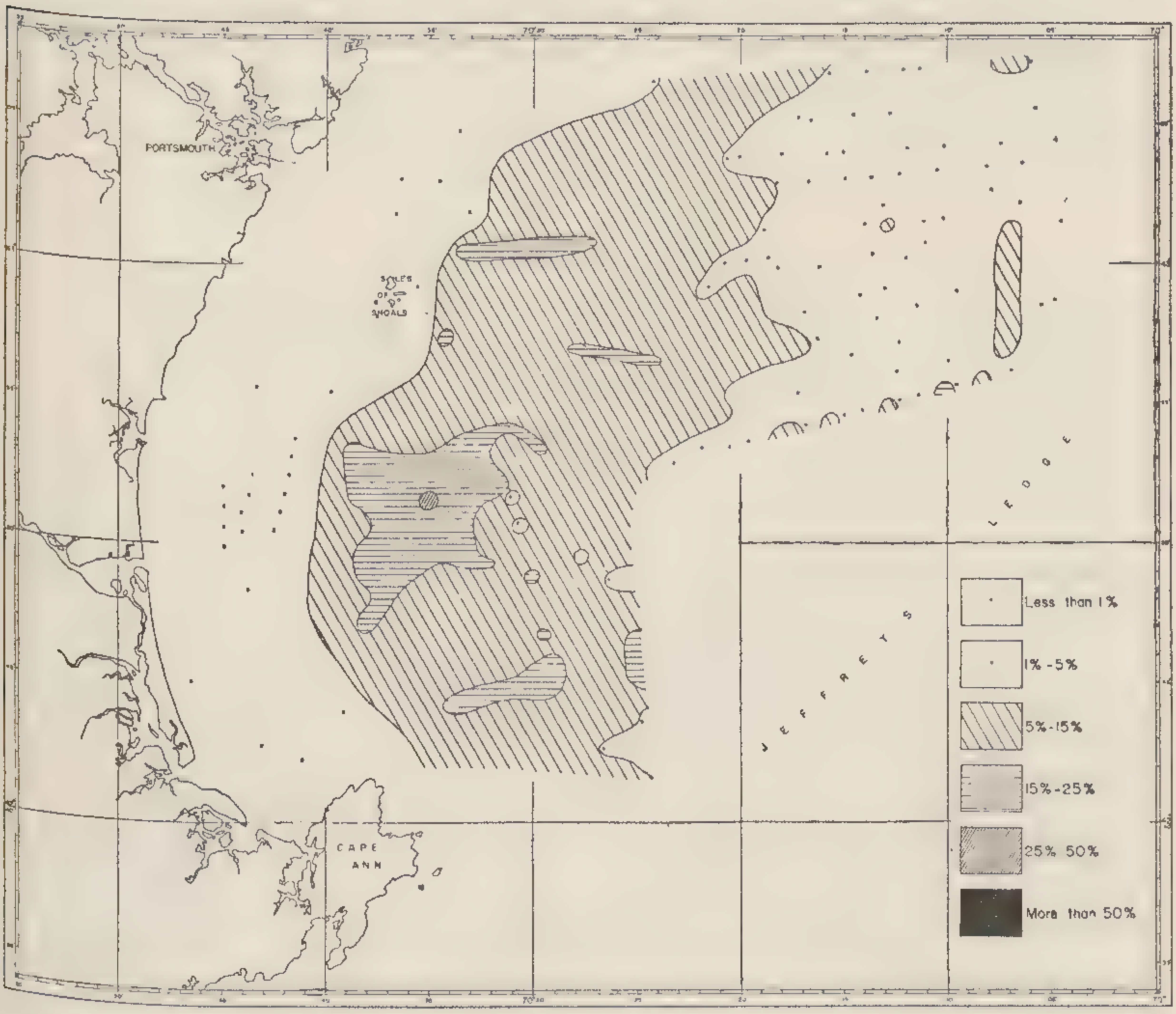


Figure 24. Distribution of *Textularia torquata* Parker in per cent of total population of benthonic Foraminifera

Eggerella advena which is characteristic of the inshore areas has living representatives only in 10 core samples taken from the shoreward edge of the mud-sand areas. The total population chart shows *Haplophragmoides glomeratum* to be abundant except on the inshore sand and gravel areas and the offshore sand areas; the distribution of living specimens of this species is similar and shows marked decrease in abundance shoreward in the southwest mud-sand area. The same samples or groups of samples have similar relative frequencies for living and total population of a species in many instances. This suggests no great post-mortem displacement of fauna in this region.

Distribution of total population of living Foraminifera is shown in Figure 6. There are three areas which have a relatively large standing population of living specimens: the Portsmouth basin, the seaward half of the southwest mud-sand area, and the northwest mud-sand area. It is of interest that there is a more or less regular decrease in living population in the southwest mud-sand area toward the shore.

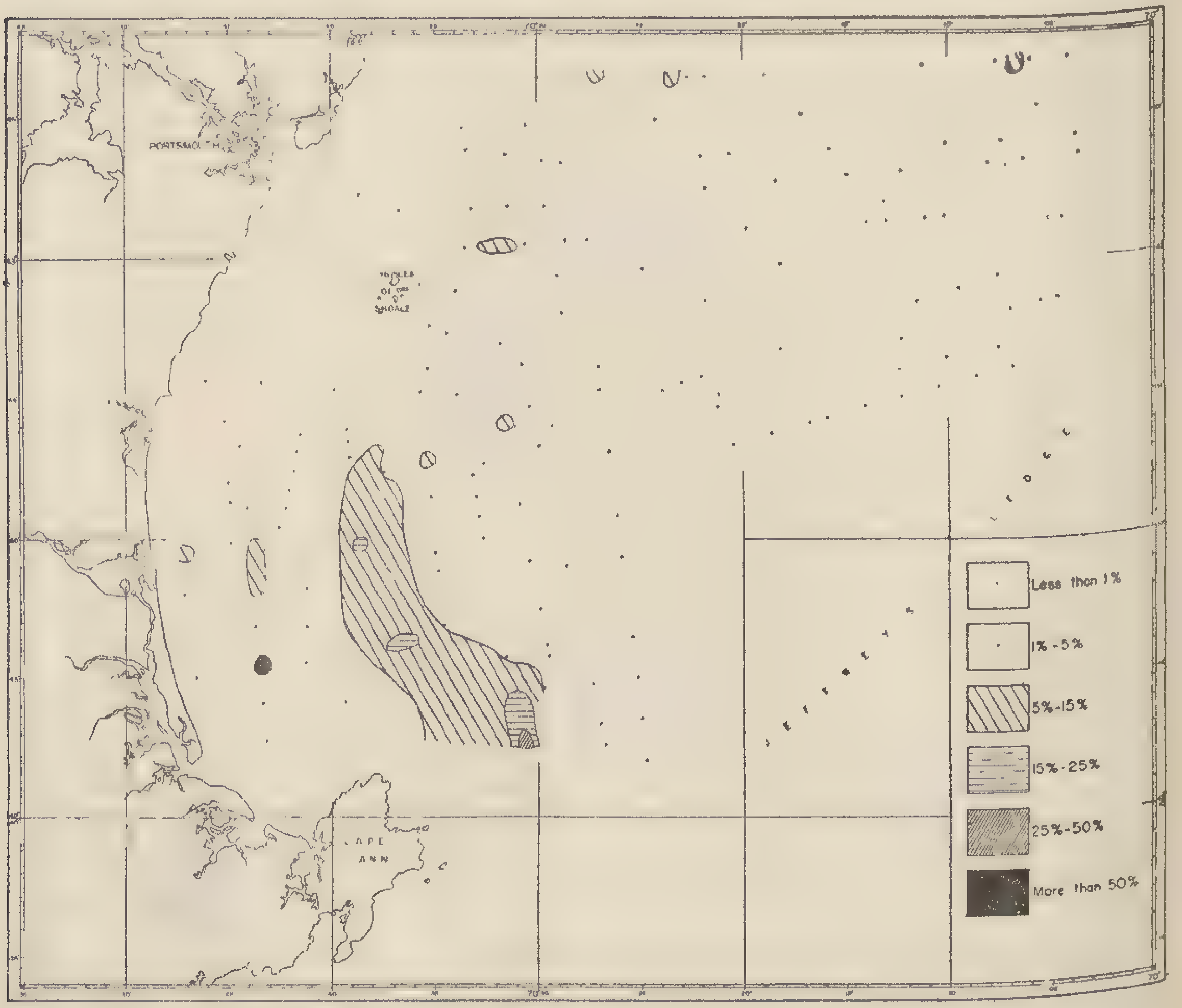


Figure 25. Distribution of *Trochammina squamata* Parker and Jones in per cent of total population of benthonic Foraminifera

It appears probable that the standing crop of benthonic Foraminifera is an index to the relative total production of benthonic organisms. The distribution of this population thus suggests that the three areas of largest population of empty tests are also the most productive. The population decrease shoreward in the southern part of the southwest silt area can be correlated with the increase of sand in the sediment and suggests that in some places mud in sediment is conducive to a relatively high population. Similar results have been obtained by

Phleger and Walton (1950) from Cape Cod Bay, off Barnstable, Mass., where there is an increase offshore with increasing mud content of the sediment.

The standing population of living benthonic Foraminifera can be converted into standard units of area for purposes of general comparison. The small coring tube samples an area which is about 9.7 sq. cm., or approximately one-thousandth of a square meter. The population distributions in the Portsmouth area suggest that the samples taken are representative of a much larger area since there are discrete areas of population intensity and recognizable population trends. The range in living population intensity in this area is approximately 1000/sq.m. to more than 100,000/sq.m., with populations greater than 50,000/sq.m. over relatively large areas in places of highest productivity.

It is of interest to note the variation in density of standing crop of Foraminifera in the southwest mud-sand area. In the offshore part of this area there is a living population up to more than 50,000/sq.m. and there is a regular decrease shoreward to less than 5000/sq.m. In the northern nearshore part of this mud-sand area there is a patch having a rather large living population, more than 25,000/sq.m. Examination of Figure 5 shows that there is a patch of a very high total population per sample south of the Isles of Shoals. The large standing crop at this place may be a reflection of high organic production to the south of the Isles of Shoals.

The only other region where comparable studies have been made on the distribution of living Foraminifera is in the northwest Gulf of Mexico (Phleger, 1951). Comparison may be made of the population density of living benthonic Foraminifera in the Portsmouth area with the population density on the continental shelf in the northwest Gulf of Mexico. The same type of sampler was used to obtain sediment materials in both areas and the ranges of depth are comparable. In the Gulf of Mexico the maximum number of living specimens at any station in any of the 12 traverses across the continental shelf is seldom greater than 25 and in some traverses is approximately 10, while most of the samples had fewer living specimens. The average number of specimens in the Gulf of Mexico area is 10.1/sample for 197 samples while at Portsmouth the average number is 31/sample for 213 samples. The approximate average standing crop is then 10,000/sq.m. in the northwest Gulf of Mexico and 30,000/sq.m. in the Portsmouth area.

Production rates of the Foraminifera may be a good index of the relative organic production in any area. This is believed probable because they are universally present, constitute a great variety of genera and species, and are all comparable in general size range of adults, except for the large forms common in calcareous areas. The standing crop of living specimens collected at any time, if representative of the area, is the result of the production which has occurred and is a clue to the population which the area will support. It would be desirable to collect seasonal samples over a period of years to obtain reliable results on relative production by the method of population sampling but this has not been possible up to the present time. The data given on the living Foraminifera populations suggest that the average production rate in the Portsmouth area is approximately three times as great as the average production rate on the continental shelf in northwest Gulf of Mexico. It would be interesting to examine living population distributions from other areas.

Foraminifera Facies

There are at least two principal faunal facies in the Portsmouth area, one developed on sand bottom (and "gravel") and the other developed on mud and mud-sand bottom. In addition there are one or more rather distinct subfacies present which can be recognized by the presence or high concentration of one species or a group of species. Certain species have overlap distributions and there are a few forms which are universally distributed throughout the area. The faunal constituents of these facies and subfacies are described below and the possible significance of the distributions is discussed in a later section.

Figure 26 is a generalized diagram of the distribution of most of the species occurring in the area. Six species are omitted from this figure and from the discussion because of their rarity. The sand facies in Figure 26 is separated into two divisions: the nearshore sand (and gravel) areas and the offshore sand areas. The mud facies, likewise, is separated into mud-sand areas and the Portsmouth basin, the principal mud area. The glacial till areas are not separately treated for practical reasons. The fauna on these areas is generally closely allied to that in mud and sand but occasionally sand facies species are present. These subdivisions, while somewhat arbitrary, bring out certain details of distribution which are considered important. The distributions as charted in Figure 26 are generalized on the basis of percentage frequency and relative number of stations at which a species is present. The three subdivisions of low frequency, intermediate frequency, and high frequency are intended as generalizations. The data on which these are based are found in Tables 2 to 7, in Figures 7 to 25, and in the written discussions of the distribution of the species.

Sand facies. The following species occur with high or intermediate frequencies on the sand facies and appear to be restricted to that facies:

Cassidulina algida
Cibicides lobatulus
Elphidium articulatum
Elphidium incertum var. *clavatum*
Elphidium subarcticum

The following species are generally restricted to various sand areas and occur in low frequency:

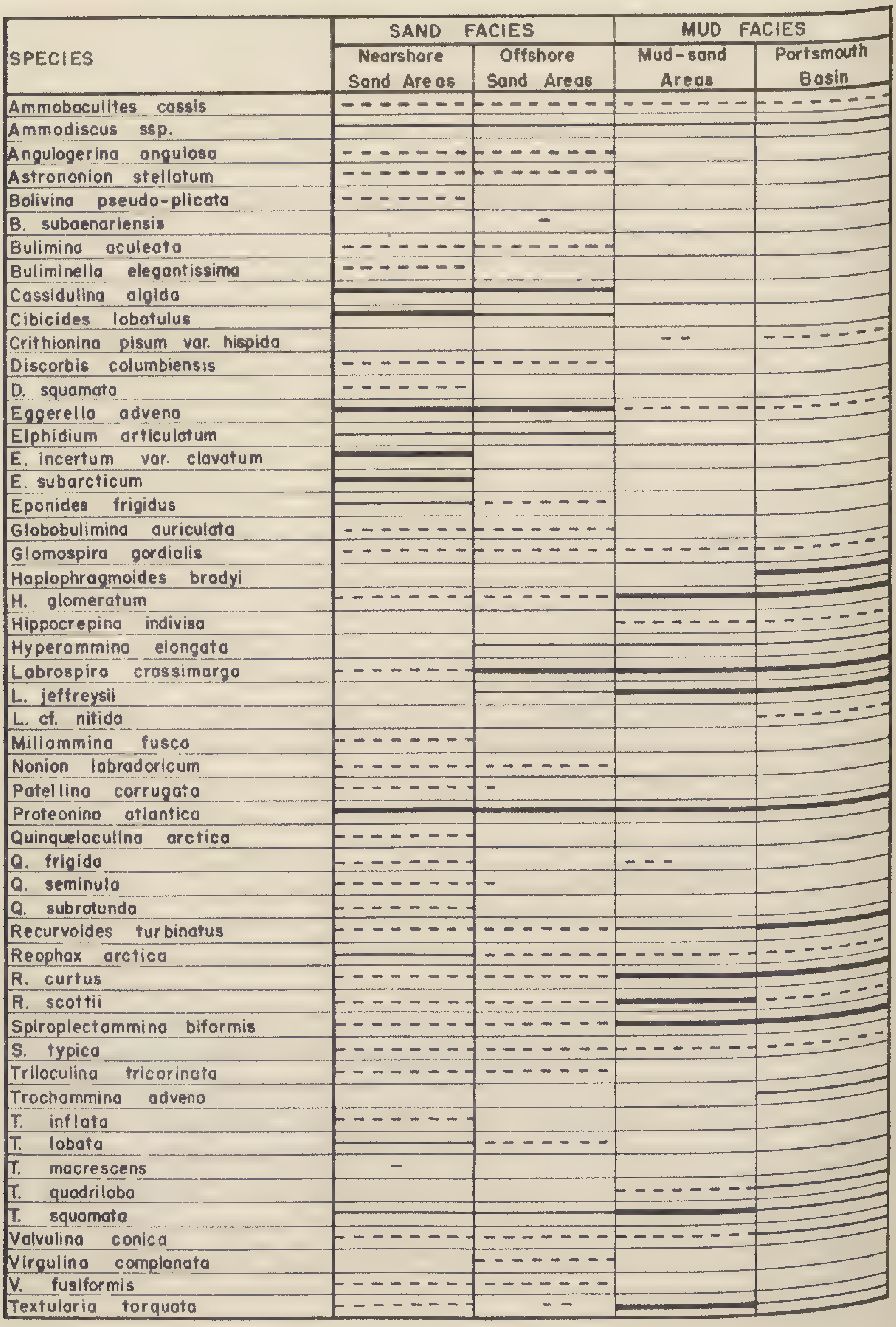
Angulogerina angulosa
Astrononion stellatum
Bolivina pseudoplicata
Bolivina subaenariensis
Bulimina aculeata
Buliminella elegantissima
Discorbis columbiensis
Discorbis squamata
Eponides frigidus
Miliammina fusca
Nonion labradoricum
Patellina corrugata
Pseudopolymorphina novangliae
Quinqueloculina arctica
Quinqueloculina subrotunda
Quinqueloculina seminula
Triloculina tricarinata
Trochammina inflata
Trochammina lobata
Trochammina macrescens
Virgulina complanata
Virgulina fusiformis

Eggerella advena is abundant on sand areas, especially the inshore areas, but is present in low frequencies on other bottom types. *Labrospira crassimargo* is especially characteristic of the mud facies but does occur in rather high frequencies on some offshore sand areas. *Reophax scottii* is of very high frequency throughout the mud facies but occurs in appreciable numbers at many of the stations in the sand facies.

Distribution of four rare species appears to be related to the mouth of the Merrimack River, being essentially restricted to areas off the river mouth or to the south of it.

These species are:

Discorbis squamata
Miliammina fusca
Trochammina macrescens
Trochammina inflata



SPECIES	SAND FACIES		MUD FACIES	
	Nearshore Sand Areas	Offshore Sand Areas	Mud-sand Areas	Portsmouth Basin
Ammobaculites cassis	- - - -	- - - -	- - - -	- - - -
Ammodiscus ssp.	────	────	────	────
Angulogerina angulosa	- - - -	- - - -		
Astrononion stellatum	- - - -	- - - -		
Bolivina pseudo-plicata	- - - -			
B. subaenariensis		-		
Bulimina aculeata	- - - -	- - - -		
Buliminella elegantissima	- - - -			
Cassidulina algida	━━━━	━━━━		
Cibicides lobatulus	━━━━	━━━━		
Crithionina pisum var. hispida			- -	- - - -
Discorbis columbiensis	- - - -	- - - -		
D. squamata	- - - -			
Eggerella advena	━━━━	━━━━	- - - -	- - - -
Elphidium articulatum	────	────		
E. incertum var. clavatum	━━━━			
E. subarcticum	━━━━			
Eponides frigidus	────	- - - -		
Globobulimina auriculata	- - - -	- - - -		
Glomospira gordialis	- - - -	- - - -	- - - -	- - - -
Haplophragmoides bradyi				━━━━
H. glomeratum	- - - -	- - - -	━━━━	━━━━
Hippocrepina indivisa			- - - -	- - - -
Hyperammina elongata		────	────	────
Labrospira crassimargo	- - - -	━━━━	━━━━	━━━━
L. jeffreysii		────	━━━━	━━━━
L. cf. nitida				- - - -
Miliammina fusca	- - - -			
Nonion labradoricum	- - - -	- - - -		
Patellina corrugata	- - - -	-		
Proteonina atlantica	━━━━	━━━━	━━━━	━━━━
Quinqueloculina arctica	- - - -			
Q. frigida	- - - -		- - -	
Q. seminula	- - - -	-		
Q. subrotunda	- - - -			
Recurvoides turbinatus	- - - -	- - - -	────	━━━━
Reophax arctica	────	- - - -	- - - -	- - - -
R. curtus	- - - -	- - - -	━━━━	━━━━
R. scottii	- - - -	- - - -	━━━━	- - - -
Spiroplectammina biformis	- - - -	- - - -	━━━━	━━━━
S. typica	- - - -	- - - -	- - - -	- - - -
Triloculina tricarinata	- - - -	- - - -		
Trochammina advena				────
T. inflata	- - - -			
T. lobata	────	- - - -		
T. macrescens	-			
T. quadriloba			- - - -	────
T. squamata	────	────	━━━━	────
Valvulina conica	- - - -	- - - -	- - - -	────
Virgulina complanata		- - - -		
V. fusiformis	- - - -	- - - -		
Textularia torquata	- - - -	- -	━━━━	────

Figure 26. Generalized distribution of Foraminifera according to sedimentary facies. Heavy lines indicate most abundant; solid thin lines indicate intermediate abundance; dashed lines indicate lowest relative abundance.

Eggerella advena also has its greatest frequency in the nearshore sand south of the Merrimack River where it is the dominant member of the fauna at many stations. *Quinqueloculina arctica*, on the other hand, is found in this facies only north of the Merrimack River.

Cibicides lobatulus is the dominant member of the fauna off the Isles of Shoals and Hampton Beach. *Discorbis columbiensis* also has its greatest frequency off Hampton Beach. These are forms which live attached to weed, rocks, shells, etc. Their abundance in this area undoubtedly is to be correlated with the presence of rocky, stony, shelly, and coarse sand bottom. These bottom types furnish good attachment for the large marine algae and also probably attachment for these two species.

The following species appear to be restricted to the inshore sand areas and generally are not present on the offshore sand areas:

Elphidium incertum var. *clavatum*
E. subarcticum
Bolivina pseudo-plicata
Buliminella elegantissima
Discorbis squamata
Miliammina fusca
Quinqueloculina arctica
Q. subrotunda
Trochammina inflata

Virgulina complanata was only found in offshore sand areas. *Bolivina subaenariensis* was found only at one station on an offshore sand area.

Mud facies. The following species have high frequencies in the mud facies and are especially characteristic of that facies although most of them are present in lower frequencies at many stations in the sand facies:

Haplophragmoides bradyi
H. glomeratum
Labrospira crassimargo
L. jeffreysii
Recurvoides turbinatus
Reophax curtus
R. scottii
Spiroplectammina biformis
Textularia torquata

The following species are restricted to the mud facies but are relatively low in frequency:

Crithionina pisum var. *hispida*
Hippocrepina indivisa
Labrospira cf. *nitida*
Trochammina advena
T. quadriloba

Labrospira nitida and *Trochammina advena* are essentially restricted to the Portsmouth basin. *Haplophragmoides bradyi* occurs in rather high frequencies and is also restricted to the Portsmouth basin and its borders. *Crithionina pisum* var. *hispida* is largely restricted to the Portsmouth basin but also is present at a few stations in mud and sand. *Trochammina squamata* has its highest frequency in the southwest mud-sand area and it may be especially characteristic of mud-sand bottom sediment; this species is rather universally distributed throughout the area on all types of sediment but in lower frequencies.

Reophax scottii is especially characteristic of the mud-sand areas and reaches its greatest abundance near the shoreward edge of the southwest mud-sand area; it also occurs at very low frequency in several other samples.

Textularia torquata reaches its highest frequency in the mud-sand areas.

There is an additional group of species which are universally distributed in the Portsmouth area. *Proteonina atlantica* is the most abundant of these universal species; this species is perhaps the most characteristic one for the area as a whole. The following forms are of lower frequencies but are universally distributed:

Ammobaculites cassis
Ammodiscus
Glomospira gordialis
Spiroplectammina typica

Reophax arctica also is of universal distribution, at low frequencies, but has a slightly greater local abundance in the southwest sand area.

FORAMINIFERA IN SHORT CORES

The vertical distribution of Foraminifera was studied from 18 of the short cores which were taken from the mud facies area, and comprising 174 separate samples. The Foraminifera were examined from the bottom samples of approximately 30 additional cores. Many of the short mud cores contain a somewhat different sediment in the lower section than in the upper section, especially those taken from the vicinity of the Portsmouth basin. In the upper part of these cores the sediment is of predominantly silt sizes and may be described as a soft mud; the lower section has clay sizes predominating and has a clay-like plasticity in many samples.

The upper fauna in the cores is described in the previous section. The lower fauna is quite distinctive from the upper one and may be characterized as a calcareous fauna, in which the greatest number of specimens and of species are of various calcareous Foraminifera. This is remarkably different from the upper core fauna in the mud facies which is composed almost exclusively of arenaceous species.

The lower core fauna, at most stations examined, is dominated by *Globobulimina* (*Desinobulimina*) *auriculata* and *Nonion labradoricum* which together usually constitute more than 50 per cent of the fauna. The following calcareous species are somewhat less abundant but constitute an important element of the lower fauna in a large number of samples:

Cassidulina algida
C. islandica var. *minuta*
C. norcrossi
Elphidium incertum var. *clavatum*
Eponides frigidus
Virgulina complanata

The following calcareous species are lower in general frequency:

Angulogerina angulosa
Astrononion stellatum
Bolivina subaenariensis
Bulimina aculeata
Cibicides lobatulus
Elphidium articulatum
Nonionella auricula
Pullenia bulloides
Pyrgo subsphaerica
Quinqueloculina seminula
Q. subrotunda
Robertina cf. *charlottensis*
Virgulina fusiformis

The following arenaceous species are present in the lower fauna but usually are of considerably lower frequency than in upper samples of the same cores:

Eggerella advena
Haplophragmoides glomeratum
Labrospira crassimargo
L. jeffreysii
Proteonina atlantica
Reophax curtus
Spiroplectammina biformis
Textularia torquata
Trochammina squamata

Proteonina atlantica is the most prevalent arenaceous species in the lower fauna.

All the species in the lower core fauna are living in the Portsmouth area at the present time except *Pullenia bulloides, Cassidulina islandica* var. *minuta,* and *Robertina* cf. *charlottensis*; these three species may exist in the area but were not discovered in the samples collected. All the calcareous species characteristic of the lower fauna are at present confined to the sand facies areas. The lower fauna arenaceous species are at present characteristic of the mud facies and do not occur in any abundance in the sand facies; *Proteonina atlantica* is an exception, common in both facies.

Specimens of planktonic Foraminifera were found in a few samples containing the lower core fauna in 15 of the 18 cores studied, although no planktonic species occurred in the upper fauna from the same cores. *Globigerina bulloides* is the most common species in these samples and the following additional planktonic species are present:

Globigerina inflata
G. eggeri
G. pachyderma
G. sp.
Globorotalia scitula

The distribution of these species in the cores can be obtained by examining Tables 13 to 18.

DISCUSSION

Field and Laboratory Methods

One of the perennial problems in marine sedimentology is whether a small sample of sediment taken by means of one of several different sampling devices is characteristic of the much larger area it is presumed to represent. This is a complex problem with variables. In the Portsmouth area the distribution of Foraminifera populations can be used as an indirect method of determining the accuracy of the sampling methods and spacing.

A study of the population patterns for different species on Figures 7 to 25 shows that they have distributions which appear to be reasonable for marine organisms. An examination of the areal chart of *Reophax curtus* (Fig. 21) may be used as an example. There are three large areas of high frequency of *R. curtus* in the principal areas of the mud facies where this species constitutes more than 25 per cent of the population, and there is a gradual decrease in frequency in all directions away from these centers. The actual frequency data show that the samples fall naturally into areal units which can be plotted, and are not distributed in a haphazard manner. *Eggerella advena* (Fig. 9) may be taken as an example of a sand facies species; it is most abundant on the southwest sand area and the numerous records of its occurrence show a regular decrease in abundance toward the southwest mud-sand area. Examination of areal plots of all the species shows that the distributions are naturally grouped so that they comprise areal units which can be mapped and which can be explained on theories of areal radiation of marine organisms. The consistency of these data indicates that the type and distribution of the samples give a good picture of the distribution of faunal variables in the area covered.

It is unfortunate that it was necessary to use different types of sampling gear in this area because of the variation in nature of the sediments. The short coring tube collects an undisturbed sample which has a constant area and in which the size and thickness of the surface sample can be controlled easily. Moreover, the actual surface of the sediment is a part of the sample. The orange-peel dredge, on the other hand, collects a sample, variable in size, which comes from a varying depth within the sediment; the sediment has had little general mixing although there is some disturbance due to washing en route to the surface of the water or on transferring the material on board ship. The material collected by the Stetson-Iselin sampler is not washed en route to the surface, since it is sealed in the collecting tube, but it is thoroughly mixed while being extracted from the tube; this gear collects a sample which varies in size and which includes a variable area and thickness of sediment. The samples for study taken from the orange-peel dredge and from the Stetson-Iselin sampler were roughly equal in size to those studied from the core samples. It was not convenient to make them actually equivalent in size due to the difficulty of judging size of sediment samples, and some samples may be a little larger than others. This probable size inequality does not affect percentage distribution of species but may reduce the reliability of the total population data for the sand facies areas.

The desirability of using species instead of genera in ecological studies of Foraminifera is well demonstrated by the present results. The advantages of a relative frequency system in percentage of total fauna in recording occurrences also are demonstrated. Both these principles may be illustrated by distribution of the species of *Trochammina* and *Haplophragmoides,* and to a lesser extent by the *Labrospira* species. *Trochammina squamata* is most characteristic of the mud-sand areas and is present in greatly reduced percentages on other types of sediment; *T. quadriloba* occurs on mud-sand and mud; *T. advena* is confined to the Portsmouth basin; *T. lobata* is confined to the sand facies; and *T. macrescens* is reported only from the sand facies. If the genus as a whole had been treated without regard for the various species, the conclusion would have been that *Trochammina* is generally characteristic of the entire area although it has a somewhat higher frequency on the mud facies. *Haplophragmoides glomeratum* occurs in the entire area but is extremely abundant on all mud facies areas; *H. bradyi* is restricted to the mud of the Portsmouth basin where it is quite abundant. *Labrospira jeffreysii* is abundant throughout the mud facies; *L.* cf. *nitida*, while rare, is confined to the Portsmouth basin.

It is believed that the methods of taking the census of the living population give a true distribution picture. This evaluation is based largely on the good correlation between the population frequencies of empty tests and living specimens of the same species. The major contributions of this technique are considered to be: (1) establishing the amount of standing crop and thus establishing a means for comparative production studies on this basis, (2) demonstration that a species is living in the area where it is found, and (3) collection of data which eventually will make it possible to estimate relative rates of deposition.

Relationships of the Modern Fauna

It is of interest to attempt to place the geographic affinities of the fauna from this area. Cape Cod is the most effective temperature and thus ecologic barrier along the northern part of the east coast of the United States and effectively limits the north-south distribution. Any attempt to summarize the distribution of modern species of Foraminifera is beset by the following handicaps: (1) there has been insufficient study of faunas throughout the world to establish more than a general idea of distribution of these forms, and (2) the determination of species in many faunal records is either inaccurate or the reliability of identifications cannot be assessed because of insufficient data given with the reports. The general paucity of reliable frequency data on distribution records should also be indicated.

The Portsmouth fauna may be divided into 3 groups of species for determining geographic affinities. One group of species occurs only north of Cape Cod and is principally known from the Arctic; a second group is known only from south of Cape Cod; and a third group is present in both regions.

The following Portsmouth area species have been reported only from north of Cape Cod and principally from Arctic regions:

Ammobaculites cassis
Astrononion stellatum
Cassidulina algida
C. islandica var. *minuta*
Labrospira jeffreysii
Nonion labradoricum
Recurvoides turbinatus
Reophax arctica
Trochammina quadriloba

Nonionella turgida and *Cassidulina islandica* var. *minuta* are found only in the lower core fauna.

The following Portsmouth area species also are reported only from south of Cape Cod and are not recorded from the Arctic:

Ammodiscus minutissimus
Elphidium advenum var. *margaritaceum*
E. articulatum
E. excavatum
Eponides umbonatus
Haplophragmoides bradyi
Labrospira cf. *nitida*
Miliammina fusca
Pyrgo subsphaerica
Reophax scottii
Trochammina advena
T. lobata
T. macrescens

The remainder of the species are known in both areas.

Considerably more is known of the Foraminifera faunas from south of Cape Cod than from the Arctic. The absence of records of a species from south of Cape Cod therefore suggests somewhat greater reliability than its absence from the Arctic. In general the species previously known only from south of Cape Cod are more rare at Portsmouth than those characteristic of the Arctic. These data suggest that the Portsmouth fauna may be considered somewhat intermediate between the continental shelf fauna immediately south of Cape Cod and the Arctic fauna and further suggest that the general affinity is perhaps more with the Arctic assemblage than with the southern one. It is quite possible that the southern extent of the Arctic forms may be somewhat more critical than the northern distribution of southern types, for reasons already given. The group of species which are distributed through a wide range of latitude are considered to be those which have a wide range of temperature tolerance. The fauna of the Portsmouth area is considered to be on the southern fringe of Arctic affinities.

Significance of Facies Distribution

Distribution of the Foraminifera in rather discrete facies which can be correlated with sediment type is a striking fact in the Portsmouth area. Any attempt to explain the distribution requires analysis of all the environmental conditions which are sufficiently well-known to be significant in this discussion.

It is shown in a preceding section that the temperature cycle is relatively uniform within the area. It is quite clear however, that some parts of the area may be expected to have somewhat different temperature cycles if conditions of the bottom water only are considered. The inshore water, shallower than 30 to 50 m., is expected to have the greatest yearly temperature range, from a monthly mean minimum of about 2°C to a maximum of about 18°C. The deep area of the Portsmouth basin, on the other hand, has relatively little seasonal temperature range, approximately 3°C to 6°C. The same low temperature range obtains for any part of the area having a depth greater than about 60 to 75 m. This greater depth range includes the mud-sand areas, some of the glacial till, and all of the mud facies. The seaward boundary of the inshore sand in the southwest part of the area approximately coincides with the 60 m. contour. The offshore sands, especially those on Jeffreys Ledge appear to extend to somewhat greater depth; it is suggested that some of this extended depth range may be due to mass movement of material along the rather steep slopes on the seaward side of the Portsmouth basin. It is apparent that the sand facies contains the Foraminifera which are adapted to pronounced seasonal ranges of temperature, as indicated, and the mud faunal facies is one adapted to lower temperatures and smaller seasonal range.

The salinity is relatively uniform for the area except for the general decrease shoreward and the somewhat higher salinity in the deeper parts of the area. The nearshore sand areas have a somewhat lower seasonal salinity minimum but this would not apply to the offshore sand areas where the salinity is uniform throughout the year. This relatively lower salinity may be of some importance in the ecology of the nearshore sand facies. The species which are confined to the nearshore sand, listed above, may be in part limited by salinity factors. *Trochammina inflata*, *T. macrescens*, and *Miliammina fusca*, listed as three of the species occurring on the nearshore sand only south of the Merrimack River, are also reported from the Barnstable, Massachusetts, area by Phleger and Walton (1950). In the latter area they are characteristic only of the marsh area and only occasional specimens are found outside the marsh where they appear to have been carried by tidal currents. It is suggested that these species in the Portsmouth area probably were carried out of marshes adjacent to the southern part of the coast and do not reflect ecologic conditions at the few localities where they were collected. Their occurrence here is thus believed due to the proximity to large areas of marsh and the presence of strong tidal currents which provide adequate transportation.

The depth ranges of several of the species from the Portsmouth area are known from Parker's work on the continental shelf (1948). The following species restricted to the sand facies are characteristic of Parker's Zone 2, with a lower depth limit of about 90m:

Elphidium incertum
E. subarcticum
Bolivina pseudoplicata
Trochammina lobata
Quinqueloculina seminula

The following sand facies species occur in Parker's Zone 3 which is deeper than 90m:

Virgulina fusiformis
Bolivina subaenariensis
Bulimina aculeata
Nonion labradoricum
Globobulimina (Desinobulimina) auriculata

Eggerella advena, which is so abundant in the inshore sand facies, is listed by Parker as ranging to a maximum depth of 121m. The following mud facies species are reported as occurring in Parker's Zone 3 and not in Zone 2:

Haplophragmoides glomeratum
Valvulina conica

Buliminella elegantissima, a sand facies species, is restricted to depths less than about 100m., in the northwest Gulf of Mexico according to Phleger (1951). *Haplophragmoides glomeratum* and *H. bradyi* occur at all ranges of depth greater than about 100m. in the northwest Gulf of Mexico.

These comparisons demonstrate that some of the species present in the Portsmouth area have similar depth ranges in other regions. It is possible that additional information of Foraminifera depth ranges in the North Atlantic will show additional correlations. It should be indicated that essentially nothing is known about depth ranges or any other distribution factors from Arctic regions, and since the Portsmouth fauna contains many Arctic elements, depth comparisons are thus made more difficult. It is the opinion of the writer that there is as significant depth zonation in the present area as for areas elsewhere.

The distribution records of the few Portsmouth species which occur in the Barnstable, Massachusetts, area and in the Long Island Sound-Buzzards Bay area have been examined for type of sediment providing the substratum for the species in those areas. The habitat of the same species in these other areas is not especially characteristic of particular types of bottom. Two outstanding exceptions are *Cibicides lobatulus* which may be largely restricted to sand and *Reophax scottii* which is largely restricted to mud. The presence of the modern sand facies species in the fine-grained mud of the lower parts of the short cores from the present area is evidence in this connection. It seems probable that sediment type has little or no effect, in itself, upon the distribution of most of the Foraminifera species in the Portsmouth area.

The Core Faunas

The most important general features of the core faunas are the striking differences between the upper and lower faunas and the fact that the lower core faunas are essentially the same as that of the modern sand facies. The boundary between the two faunas is rather sharp in many of the cores. It is of interest to speculate on the causes for virtual elimination of the present sand facies from the mud facies areas, although a completely satisfactory explanation is difficult or impossible at the present stage of our knowledge.

The faunal change with time appears to have been rather abrupt on the mud facies areas if the core data are correctly interpreted. This implies some rapid change of environmental conditions which eliminated the calcareous species of the lower core fauna from the mud and mud-sand areas. The repopulation of the mud facies areas with a completely arenaceous assemblage may have been accomplished in either of two ways: either the arenaceous species were introduced from outside the area or they survived the change in environment and increased in abundance in the available habitats.

The calcareous fauna may have invaded and populated the sand facies areas because it was either the only available environment or because the environment was more suited to their survival and proliferation. It is possible that the arenaceous species became so abundant in mud areas that they exerted sufficient population pressure to exclude other forms. It appears, however, that the redistribution of faunas probably was connected with rise of sea level during the late glacial or post-glacial time. As the water deepened over the mud areas the environment may have become less desirable for the calcareous species which were adjusted to environments in the upper water layers and they gradually invaded the newly opened environment of the present sand facies. It is suggested above that the facies distribution is largely controlled by ecologic factors associated with depth. It is reasonable, therefore, that the shallow-water calcareous species would in general be excluded from the areas which were deepening and invade more congenial shallow areas.

The arenaceous species which were already present as a minor element of the population in the mud facies areas greatly increased in abundance and became essentially the entire mud facies fauna. A few arenaceous species, apparently well-adapted to both the principal environments in the Portsmouth area, migrated into the shallow-water areas in appreciable quantity. Other arenaceous species became approximately as abundant on the modern sand facies as they were in the mud facies at a time when sea level was lower.

It is suggested that even the lower core fauna lived in the Portsmouth area some time after the local large-scale melting of the glacial ice. Ice melting in any quantity in this area would have introduced large amounts of fresh water into the Gulf of Maine and would have caused brackish conditions. The assemblage in the lower core fauna contains no species particularly characteristic of brackish water. Longer cores are desirable from this area and from other parts of the Gulf of Maine to obtain further details of the late glacial and post-glacial history of this marine area.

SUMMARY OF CONCLUSIONS

1. Population patterns of Foraminifera species in the Portsmouth area show discrete areal units which can be mapped and which appear to be reasonable. This suggests that the sampling was representative of the area.

2. The modern Foraminifera fauna of the Portsmouth area is related to the Arctic fauna, although it contains elements also found south of Cape Cod.

3. There are two principal faunal facies. One facies is characteristic of sand areas and extends to an average depth not greater than about 60 to 75m. The other facies is developed on mud and mud-sand areas at greater depths. Some species are further restricted to mud, to sand-mud, and to inshore sand. Other species occur in uniform frequency throughout the area.

4. Chief causes for the facies distribution are believed to be ecologic factors related to water depth, principally the seasonal temperature ranges, but also salinity and numerous other factors. Salinity variations may be especially important from the mouth of the Merrimack River southward.

5. Distribution frequencies of the living fauna are comparable to

distribution frequencies of the empty tests, both of the total population and of individual species. The standing crop of living Foraminifera on the mud facies areas ranges from approximately 1000/sq.m. to more than 100,000/sq.m. The average living population was approximately 30,000/sq.m., or about 3 times as great as the average living population in nearshore areas of the northwest Gulf of Mexico.

6. The lower fauna of short cores from the mud facies areas is dominated by calcareous species, with arenaceous species in very low frequencies, the same fauna which at present lives on sand facies areas. The upper core fauna is composed of arenaceous species. It is suggested that the lower fauna lived on the present mud facies areas when the water there was shallower, that it migrated into the sand facies areas during post-glacial rise of sea level, and the arenaceous species remained in deeper waters where the environment was conducive to their proliferation.

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Contribution No. 591, Woods Hole Oceanographic Institution.

Contribution No. 6, Marine Foraminifera Laboratory.

Table 1

Location of Stations

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
2	43°00.9′	70°23.8′	110
5	42°58.2′	70°22.0′	106
8	42°55.4′	70°20.2′	148
14	42°53.4′	70°21.8′	129
18	43°05.0′	70°16.4′	144
21	43°03.6′	70°11.4′	172
22	43°03.2′	70°10.2′	162
23	43°02.8′	70°08.9′	152
24	43°02.5′	70°07.6′	143
25	43°02.1′	70°06.3′	143
27	43°01.4′	70°04.2′	104
28	43°01.1′	70°06.8′	157
29	43°00.6′	70°10.8′	175
30	43°00.2′	70°13.4′	208
31	42°59.8′	70°16.0′	160
33	42°59.1′	70°21.3′	122
34	42°52.6′	70°32.6′	95
35	42°51.9′	70°31.5′	104
36	42°51.6′	70°31.1′	112
40	42°49.8′	70°28.3′	116
41	42°49.5′	70°27.8′	107
42	42°49.2′	70°27.1′	108
48	43°03.5′	70°24.8′	95
50	43°03.5′	70°23.4′	100
52	43°03.6′	70°21.9′	107
53	43°03.6	70°21.1′	110
54	43°03.6′	70°20.4′	119

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
55	43°03.7′	70°19.8′	125
58	43°03.7′	70°17.7′	143
61	43°03.8	70°15.6′	158
62	43°03.9′	70°14.8′	162
65	43°03.0′	70°13.5′	168
67	43°02.0′	70°12.9′	172
68	43°01.5′	70°12.6′	171
71	43°00.1′	70°11.8′	180
73	42°59.1′	70°12.1′	183
74	42°59.0′	70°12.7′	182
76	42°58.7′	70°14.1′	166
80	42°58.1′	70°16.7′	152
82	42°57.7′	70°18.7′	146
85	42°56.5′	70°24.4′	114
88	42°56.7′	70°26.5′	100
90	42°56.9′	70°28.0′	93
91	42°56.1′	70°35.2′	66
96	42°54.1′	70°31.6′	88
97	42°53.7′	70°31.5′	94
98	42°53.2′	70°31.4′	96
102	42°51.3′	70°30.8′	117
103	42°50.6′	70°30.7′	110
104	42°50.1′	70°30.5′	109
105	42°49.7′	70°30.4′	108
106	42°49.2′	70°30.3′	107
107	42°48.7′	70°30.2′	105
110	42°47.4′	70°29.8′	99
111	42°47.0′	70°29.7′	98
112	42°46.6′	70°29.6′	96

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
113	42°46.2′	70°29.4′	94
114	42°45.7′	70°29.3′	93
116	42°44.8′	70°29.3′	87
118	42°45.2′	70°30.7′	90
121	42°45.9′	70°32.5′	89
123	42°46.0′	70°33.8′	90
128	42°46.3′	70°37.1′	76
131	42°46.9′	70°38.3′	73
132	42°47.4′	70°38.4′	74
133	42°47.9′	70°38.5′	73
134	42°48.3′	70°38.5′	76
135	42°48.9′	70°38.5′	75
136	42°49.4′	70°38.6′	73
137	42°49.9′	70°38.7′	73
138	42°50.9′	70°38.7′	70
139	42°51.4′	70°38.9′	69
141	42°52.4′	70°39.0′	67
142	42°52.9′	70°39.1′	65
143	42°53.4′	70°39.2′	64
144	42°54.0′	70°39.2′	61
148	42°53.1′	70°37.6′	74
149	42°52.4′	70°37.5′	76
150	42°51.7′	70°37.4′	76
151	42°51.0′	70°37.3′	78
152	42°50.3′	70°37.2′	81
153	42°49.7′	70°37.0′	80
154	42°49.0′	70°36.9′	82
155	42°48.3′	70°36.8′	85
156	42°47.7′	70°36.7′	82

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
157	42°47.0′	70°36.6′	82
158	42°46.4′	70°36.5′	79
159	42°45.7′	70°36.3′	76
160	42°45.0′	70°36.2′	72
161	42°42.8′	70°34.0′	64
162	42°43.5′	70°34.1′	67
163	42°44.2′	70°34.2′	73
164	42°44.8′	70°34.3′	81
165	42°45.5′	70°34.4′	86
166	42°46.2′	70°34.5′	88
167	42°46.9′	70°34.5′	92
168	42°48.2′	70°34.7′	100
169	42°48.9′	70°34.8′	98
170	42°49.6′	70°34.9′	96
173	42°51.6′	70°35.2′	87
175	42°52.9′	70°35.3′	80
176	42°57.4′	70°34.2′	64
178	42°55.2′	70°33.8′	73
181	42°52.3′	70°33.0′	90
182	42°51.5′	70°32.9′	98
183	42°50.8′	70°32.7′	92
184	42°50.1′	70°32.5′	92
185	42°49.4′	70°32.4′	92
186	42°48.5′	70°32.2′	99
190	42°45.7′	70°31.5′	92
192	42°44.2′	70°31.1′	86
194	42°42.8′	70°30.8′	76
196	42°55.2′	70°35.6′	67
197	42°57.5′	70°35.2′	46

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
201	42°56.9′	70°31.7′	64
203	42°56.1′	70°30.7′	89
205	42°54.7′	70°30.3′	84
207	42°53.3′	70°29.8′	150
213	42°49.0′	70°28.5′	109
215	42°47.6′	70°28.1′	100
219	42°44.8′	70°27.2′	85
221	42°43.3′	70°26.7′	78
222	42°42.6′	70°26.5′	70
223	42°41.7′	70°26.2′	49
224	42°42.1′	70°24.5′	58
226	42°43.5′	70°24.7′	82
228	42°45.0′	70°25.0′	87
230	42°46.4′	70°25.3′	99
231	42°47.2′	70°25.4′	100
234	42°49.4′	70°25.8′	122
236	42°50.9′	70°26.0′	122
239	42°53.1′	70°26.4′	131
242	42°55.3′	70°26.8′	59
243	42°56.1′	70°26.9′	64
246	42°55.5′	70°28.7′	65
247	42°55.2′	70°25.2′	73
248	42°55.3′	70°23.8′	70
249	42°55.5′	70°22.9′	111
250	42°55.8′	70°21.9′	132
253	42°56.5′	70°19.0′	143
254	42°56.7′	70°18.1′	145
255	42°57.0′	70°17.1′	148
256	42°57.2′	70°16.1′	152

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
259	42°58.0′	70°13.2′	174
261	42°58.5′	70°11.3′	174
263	42°58.9′	70°09.4′	174
265	42°59.4′	70°07.4′	174
270	43°05.8′	70°02.8′	51
271	42°59.1′	70°02.3′	67
273	42°58.8′	70°03.8′	88
274	42°58.7′	70°04.5′	100
275	42°58.5′	70°05.2′	110
277	42°58.2′	70°06.8′	127
284	42°57.1′	70°12.1′	171
287	42°56.6′	70°14.4′	162
310	42°48.2.	70°41.2′	43
312	42°46.9′	70°41.1′	41
314	42°45.6′	70°41.1′	40
315	42°43.5′	70°41.1′	31
317	42°42.2′	70°41.1′	26
319	42°40.9′	70°41.1′	13
320	42°42.5′	70°39.3′	34
322	42°44.0′	70°39.2′	37
334	42°49.1′	70°42.9′	38
335	42°50.4′	70°42.5′	41
336	42°51.5′	70°42.3′	43
337	42°51.7′	70°42.0′	43
338	42°52.4′	70°41.9′	42
339	42°53.1′	70°41.7′	50
340	42°53.7′	70°41.5′	56
342	42°55.6′	70°43.5′	34
350	42°54.2′	70°45.1′	30

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
353	42°52.1′	70°45.1′	32
354	42°51.3′	70°45.0′	32
355	42°50.6′	70°45.0′	30
356	42°49.8′	70°45.0′	29
363	42°44.8′	70°44.7′	21
372	42°42.7′	70°43.1′	21
374	42°44.1′	70°43.3′	27
376	42°45.5′	70°43.5′	27
378	42°47.0′	70°43.7′	31
380	42°48.3′	70°43.8′	34
382	42°49.7′	70°44.0′	37
383	42°50.4′	70°44.1′	37
384	42°51.1′	70°44.2′	35
385	42°51.8′	70°44.3′	36
386	42°53.3′	70°44.5′	35
388	42°53.7′	70°43.4′	35
389	42°53.0′	70°43.5′	35
390	42°52.4′	70°43.6′	37
391	42°51.7′	70°43.7′	36
392	42°51.2′	70°46.1′	28
393	42°51.0′	70°46.8′	26
395	42°55.6′	70°46.1′	21
397	42°54.4′	70°46.7′	20
402	42°49.5′	70°47.2′	22
404	42°48.0′	70°47.1′	20
406	42°46.5′	70°46.8′	17
408	42°45.1′	70°46.5′	12
410	42°43.4′	70°45.6′	9
420	42°58.4′	70°44.5′	11

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
439	43°02.2′	70°38.6′	23
451	43°00.3′	70°38.2′	25
453	42°59.1′	70°38.2′	20
466	42°55.4′	70°39.8′	56
472	42°59.1′	70°35.6′	38
474	42°58.9′	70°33.9′	58
478	42°58.3′	70°30.5′	87
480	42°58.0′	70°28.8′	73
482	42°57.8′	70°27.0′	97
486	42°57.2′	70°23.5′	118
494	42°59.3′	70°19.7′	144
496	42°59.8′	70°18.0′	152
506	43°00.1′	70°18.5′	148
507	43°00.3′	70°19.5′	137
508	42°60.0′	70°20.5′	128
512	42°59.6′	70°24.6′	100
516	42°59.3′	70°29.0′	88
520	43°00.4′	70°33.5′	59
521	43°00.4′	70°32.5′	69
522	43°00.5′	70°31.5′	79
523	43°00.5′	70°30.5′	84
525	43°00.6′	70°28.5′	85
526	43°00.7′	70°27.6′	97
528	43°00.7′	70°25.6′	96
529	43°00.8′	70°24.6′	105
530	43°00.8′	70°23.6′	110
531	43°00.9′	70°22.6′	113
533	43°01.0′	70°20.6′	128
534	43°01.0′	70°19.6′	134

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
535	43°01.1′	70°18.7′	140
540	43°01.3′	70°13.8′	170
541	43°01.3′	70°12.9′	170
543	43°01.4′	70°11.0′	169
544	43°01.5′	70°10.0′	170
552	43°01.7′	70°36.6′	37
554	43°01.7′	70°35.0′	34
556	43°01.7′	70°33.1′	49
558	43°01.7′	70°31.4′	70
560	43°01.8′	70°29.6′	84
562	43°02.1′	70°27.8′	93
564	43°02.2′	70°26.0′	93
566	43°02.3′	70°24.3′	100
569	43°02.5′	70°21.7′	116
572	43°02.7′	70°19.1′	143
573	43°02.7′	70°18.3′	137
575	43°02.8′	70°16.5′	158
577	43°02.9′	70°14.8′	158
580	43°03.1′	70°12.3′	171
585	43°03.4′	70°07.9′	158
587	43°03.5′	70°06.2′	142
590	43°03.6′	70°03.6′	96
591	43°04.3′	70°03.6′	96
592	43°04.3′	70°04.6′	105
595	43°04.2′	70°07.3′	160
598	43°04.1′	70°09.9′	168
600	43°04.0′	70°11.8′	167
601	43°03.3′	70°28.7′	78
602	43°03.4′	70°29.7′	46

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
604	43°03.6′	70°31.5′	51
606	43°03.8′	70°33.4′	40
607	43°04.0′	70°35.0′	27
610	43°04.6′	70°33.6′	37
614	43°04.7′	70°30.5′	56
618	43°04.8′	70°26.9′	77
621	43°04.9′	70°24.1′	90
623	43°04.9′	70°22.4′	82
625	43°05.0′	70°20.6′	111
626	43°05.0′	70°19.7′	120
629	43°05.1′	70°17.0′	140
632	43°05.2′	70°14.3′	152
634	43°05.2′	70°12.6′	152
642	43°05.4′	70°05.5′	119
644	43°05.5′	70°03.8′	100
645	43°07.2′	70°04.0′	116
647	43°07.1′	70°05.8′	139
648	43°07.0′	70°06.7′	142
649	43°07.0′	70°07.5′	150
653	43°06.9′	70°11.1′	168
654	43°06.8′	70°12.0′	181
656	43°06.8′	70°13.7′	152
658	43°06.7′	70°15.5′	145
660	43°06.6′	70°17.3′	126
662	43°06.5′	70°19.0′	125
663	43°06.5′	70°19.9′	118
664	43°06.5′	70°20.8′	111
665	43°06.4′	70°21.7′	102
666	43°06.4′	70°22.6′	92

Station	*N. Lat.*	*W. Long.*	*Depth in m.*
667	43°06.4′	70°23.5′	75
668	43°06.3′	70°24.4′	76
676	43°06.5′	70°28.9′	37
678	43°06.5′	70°27.2′	40
685	42°56.8′	70°07.3′	128
688	42°56.4′	70°09.7′	150
691	42°56.1′	70°12.2′	152
697	42°55.3′	70°16.9′	146
702	42°54.6′	70°21.1′	110
703	42°54.5′	70°21.9′	107
706	42°54.1′	70°24.3′	61
707	43°03.0′	70°36.4′	27
708	43°03.0′	70°34.5′	18
718	42°52.9′	70°23.1′	130
721	42°53.4′	70°20.3′	134
722	42°53.6′	70°19.4′	134
723	42°53.8′	70°18.5′	136
724	42°54.0′	70°17.6′	150
725	42°54.2′	70°16.7′	150
726	42°54.3′	70°15.6′	150
727	42°54.5′	70°14.7′	142
728	42°54.7′	70°13.8′	133
729	42°54.9′	70°12.9′	138
730	42°55.1′	70°12.0′	144
731	42°55.3′	70°11.2′	122
732	42°55.4′	70°10.2′	113
733	42°55.6′	70°09.3′	131
734	42°55.8′	70°08.4′	110
736	42°56.1′	70°06.6′	97
738	42°56.5′	70°04.7′	76

STATION	2	5	8	14	18	21	22	23	24	25	27	28	29	30	31	33	34	35	36	40	41	42	43	48	50	52	53	54	55	58	61	62	65	67	68	71	73	74	76	80	82	85	88	90	91	96	97	98	102	103	104	105	106	107	110	111	112	113	114
DEPTH IN METERS	110	106	148	129	144	172	162	152	143	143	104	157	175	208	160	122	95	104	112	16	107	108	118	95	100	107	110	119	125	143	158	162	168	172	171	180	183	182	166	152	146	114	100	93	66	88	94	96	117	110	109	108	107	105	99	98	96	94	93
TOTAL BENTHONIC POPULATION	364	187	642	517	627	724	1011	369	441	400	1854	738	348	976	454	1440	231	225	116	138	151	302	118	374	108	321	333	888	488	307	737	459	702	1080	660	473	185	475	459	879	743	518	384	252	107	102	5	293	428	132	214	63	193	558	138	446	313	660	507
BENTHONIC SPECIES IN %																																																											
Ammodiscus ssp.	6	4	9	1	1	.3	3	2	3	.7	2	1	2	.8	1	.6	1	2	3				.8	.8		2	2	2	2	.7	2		2	3	.3	1	1	.8	1	2	6	.8	.8	4	3	2		.7	9				1	1	.7	2	1	1	8
Bulimina aculeata																									17							.4																											
Cassidulina algida																									20																																		
C. norcrossi											.3														7																																		
Eggerella advena							.3		.7	.4	1	.5					2	3															.9	.4		.6			.2		.1	8	.8	3	3	5		1			.5			.4	1	.4	3	2	2
Elphidium incertum var. clavatum																									4																																		
Eponides frigidus																									2																																		
Globobulimina auriculata																									20							9																											
Glomospira gordialis		2			3					4	1						4	.4									6									2									2			7									3		
Haplophragmoides bradyi	8	8	4	24	10	41	10	29	21	12	22	3	35	8	3	3							2	5		4	8	8	13	6	13	62	20	6	15	11	37	8	15	16	5	4		.4													3	3	
H. glomeratum	42	19	8	28	15	14	7	20	11	13	16	23	10	20	17	9	32	17	17	14	11	25	24	23		16	18	14	19	20	21	11	12	13	15	17	8	7	12	25	10	22	12	2	14	6		23	12	7	16	5	18	16	16	18	14	27	18
Hormosina sp.	.3					2		3			.6												5				6	.7				2		.4				1	2	3																			
Hyperammina elongata					.8		3				1			4								.3		5			.6		1	.3		4	.9		1	4			.7	3	1							.3								.4	.3		2
Labrospira crassimargo	7	13	5	10	6	18	4	11	19	10	12	14	22	13	8	13	3	15	45	24	13	9	8	13		11	4	10	5	9	13	6	9	10	13	15	6	11	8	8	8	7	8	4	8	14	80	17	24	15	29	35	42	6	16	6	7	15	8
L. jeffreysii	4	3	4	.8	2	1	4	2	2	2	2	3	5	3	2	3	2	2	3	13	21	2	18	3		5	1	2	2	3	3	3	4	4	1	2	6	2	4	4	2	2		3	.9			1	3	6	3		.5	6		2	1	2	1
L. cf nitida						.6		.8			.1																.3	.2					6	4																									
Lagena																						.3			4																																		
Nonion labradoricum																									20							.9												.8															
Proteonina atlantica	15	25	2	3	8	3	2	3	10	10	11	6	3	12	4	7	7	1	3	4	10	10	21	32	4	20	14	14	11	9	14	3	5	8	8	20	10	5	10	15	16	21	9	19	2	1		20	3	.8	4	3	7	11	6	23	22	17	25
Quinqueloculina frigida																																																							.7	.4	.3		
Recurvoides turbinatus		4	10	14	11	7	4	13	9	13	8	22	10	13	11	7	3	4		8	5	.6		.5		6	7	7	11	7	1	.4	8	8	11	10	10	7	3	9	10	7		7	4			1	2	1	.5	3	1	.7	.7	3	3	1	1
Reophax arctica		2	1	.6	3	.3	.9	.5	.9		.3		.9	4	.4	1						.3		.3		2	.9	2	1	.7	.6			.7	.6	.4		1	2	.7	2		2	2	4	2		.3	3	.8	3	6	.5	2	4	2		1	2
R. curtus	13	11	63	17	33	10	58	9	16	30	15	7	5	23	45	44	12	4	19	12	38	38	11	17		15	34	30	26	30	23	8	31	35	27	15	19	50	34	10	27	3	20	17	13	3	20	21	24	61	22	30	14	25	24	17	11	16	9
R. scottii					2	3		2	9			1	.6				4	2						.5					1	3	.6							1	1	3	1		3	1	26	14									6				3
Spiroplectammina biformis		4	.5	.4	4	.8	5	1	2	5	2	13	5	4	5	.8	17	16	3	7	3	7	5			7	1	4	3	11	4		2	6	2	4		2	4	4	5	7	16	17	11	19		6	12	5	8	11	9	11	7	10	17	7	6
S. typica										.4	.1																5						.6									.6	4	2							.5			2	2			.6	
Textularia torquata		5		1	2		2		.9	1	1	7	2	2	3	1	16	32	3	15		5	3	2		11		3	2	3	2	.4	2	3	2	2		2	.9	2	5	19	27	19	7	29		7	13	3	13	2	5	18	13	14	18	8	20
Trochammina advena		.5	.5		.2					.4	1	.3												.3		.3		1	.4		.6		3	.7	.9	2		.4			5																		
T. quadriloba		2			.2			2	.2	.4	.3	.4		.4												.3		.2	.2	3			6			.2			.7	.3	.4	.4								.8									.2
T. squamata								.8	2	.7	.6						2									.9		.2			.4			1		.4						.2			.9	7		.3	.2				1		.7			.3	3
Valvulina conica					2			.8	2		.9	5	3											.3					.2	.3					.3	.2				.3	.1			.4															

Table 2. Occurrences of Foraminifera species at stations 2–114

STATION	116	118	121	123	128	131	132	133	134	135	136	137	138	139	141	142	143	144
DEPTH IN METERS	87	90	89	90	76	73	74	73	76	75	73	73	70	69	67	65	64	61
TOTAL BENTHONIC POPULATION	408	33	96	66	162	516	112	622	199	177	161	174	171	159	312	248	317	246
BENTHONIC SPECIES IN %																		
Ammobaculites cassis														6		8	3	5
Ammodiscus ssp	3	6	2	3	6	3		6	5	2		6	6	1	9	4	3	
Eggerella advena	4	9	2		9	6	23	3	12	4	6	11	13	13	25	32	29	42
Glomospira gordialis						2											3	8
Haplophragmoides bradyi																		
H. glomeratum	30		9	3	4	8	5	2	1	2	5	6	3	4	2	3	6	2
Hippocrepina indivisa								.3	3	.6					.3	.4		.4
Hyperammina elongata	5																	8
Labrospira crassimargo	4	6	7	20	7	2	2	3	4	1	6	3	5	6	1	6	5	8
L. jeffreysii	1		2	1														
Proteonina atlantica	11		1		2				2		.6		2	4	1	4	6	8
Quinqueloculina frigida																		
Recurvoides turbinatus	1			1	2	2	9		2		2		3		3	3	1	4
Reophax arctica			5	3	3	2	2	1	1	4	2	3	2	1	3		1	8
R. curtus	7	18	22	14	2	1	2	6	4	1	8	2	11	4	4	11	3	7
R. scottii	[illegible]	15	.2	12	19	49	17	64	43	33	25	16	29	29	21	4	8	11
Spiroplectammina biformis	16	6	14	15	19	9	20	3	9	12	15	20	18	6	8	16	14	9
S. typica	1					2				1	4	1					1	
Textularia torquata	16	15	5	12	16	16	18	11	8	27	15	15	6	19	25	15	17	10
Trochammina lobata						2		2						.6				1
T squamata	2	15	18	9	17	12	9	14	8	11	11	22	6	11	7	3	4	2

STATION	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
DEPTH IN METERS	74	76	76	78	81	80	82	85	82	82	79	76	72	64	67	73	81	86
TOTAL BENTHONIC POPULATION	77	52	94	76	94	46	46	53	67	118	168	365	336	210	139	127	80	119
BENTHONIC SPECIES IN %																		
Ammobaculites cassis												3	3					
Ammodiscus ssp	3	2	1	1	2	4	2	4	3	3		3	6	11	3	10	5	
Eggerella advena	13	2	2	4	6	4		2	6	10	5	14	21	35	32	4	1	
Glomospira gordialis			1										6			8		
Haplophragmoides bradyi																		
H. glomeratum	3	8	6	3	4	13	15	6	4	8	2	8	2	.5		5	9	8
Hippocrepina indivisa																.8		
Hyperammina elongata													3					
Labrospira crassimargo	1		8	4	6	4	6	6	7	5	2	2	2		4	3	18	15
L. jeffreysii									1									2
Proteonina atlantica				11	4	9		4	1			.3	2		7		4	8
Quinqueloculina frigida																		
Recurvoides turbinatus	1		2		1		4	4		8		3	3		7	2	2	2
Reophax arctica	3	6	11	4	1	13	6	7			10	5	1	5	4	5	4	4
R. curtus	4	10	11	12	3	4	20	13	6	6	3	2	19	1	4	8	12	27
R. scottii	20	.2	10	20	6			9	24	32	42	52	10	15	19	19	8	13
Spiroplectammina biformis	23	15	19	16	30	22	22	23	24	22	8	10	14	14	11	13	18	13
S. typica			1					2				1	6	1	7			
Textularia torquata	16	17	22	22	22	22	15	15	7	9	10	11	13	11	13	20	14	12
Trochammina lobata														.5				
T squamata	8	27	8	14	13	4	9	6	15	10	16	5	5	10	7	10	6	2

STATION	166	167	168	169	170	173	175	176	178	181	182	183	184	185	186	190	192	194
DEPTH IN METERS	88	92	100	98	96	87	80	64	73	90	98	92	92	92	99	92	86	76
TOTAL BENTHONIC POPULATION	82	84	52	149	171	115	294	137	136	171	98	134	168	88	129	155	87	95
BENTHONIC SPECIES IN %																		
Ammobaculites cassis																		
Ammodiscus ssp		1		1	2	2	7	7			1		6	2	3	6	3	
Eggerella advena			2			8	5	20	6	2		7		2			2	6
Glomospira gordialis							2	7										1
Haplophragmoides bradyi						8												
H. glomeratum	9	5	10	8	8	13	7	20	11	12	18	19	11		19	10	14	3
Hippocrepina indivisa																		
Hyperammina elongata																		
Labrospira crassimargo	23	13	19	37	14	3	5	9	6	8	10	7	8	11	18	23	14	10
L. jeffreysii			4	2		.8	.7	7		.6	1		2		2	.6	1	
Proteonina atlantica	1		15	4	2	3	2	12	14	19	6	7	2	2	2	2		1
Quinqueloculina frigida	1													1				
Recurvoides turbinatus	1	1	4	7	3		7	7		3	4		4	1	2	6	1	
Reophax arctica	1	5	4	7	5	3	2		7	6	7	4	2	1	4	4	3	
R. curtus	19	20	16	20	26	13	10	3	29	20	8	29	49	43	31	25	12	7
R. scottii	5	11	10			7	8	1	10	7		1	2	2				22
Spiroplectammina biformis	15	21	12	10	16	21	16	6	12	8	15	21	9	12	11	17	17	4
S. typica					6	3	3				2	7					2	
Textularia torquata	17	20	6	9	19	30	26	22	10	17	21	14	11	20	7	13	7	7
Trochammina lobata																		
T squamata	7	1		7	3	8	7	3	1	5	5	1	2			3	23	35

Table 3. Occurrences of Foraminifera species at stations 116–194

STATION	196	197	201	203	205	207	213	215	219	221	222	223	224	226	228	230	231	234	236	239	242	243	246	247	248	249	250	253	254	255	256	259	261	263	265	270	271	273	274	275	277	284	287	310	312	314	315	317	319	320	322	334	335	336	337
DEPTH IN METERS	67	46	64	89	84	150	109	100	85	78	70	49	58	82	87	99	100	122	122	131	59	64	65	73	70	11	132	143	145	148	152	174	174	174	174	51	67	88	100	110	127	171	162	43	41	40	31	26	13	34	37	38	41	43	43
TOTAL BENTHONIC POPULATION	378	7392	586	453	184	81	454	253	813	332	429	998	4568	1568	414	486	335	656	251	490	1066	3000	3744	2816	5680	2184	393	567	622	578	1125	1212	1288	423	669	198	3488	520	5520	2200	1260	1028	566	367	124	94	614	3080	336	546	522	1023	4392	3424	4640
BENTHONIC SPECIES IN %																																																							
Ammobaculites cassis	.5				5	1			4																																							.1							
Ammodiscus ssp.			5	1	2	5	.4	3	1	6	.7	1		.8	2	1	1	2	.8	.8	.4		9	.3	6	7	8	.8	1	7	3	2	2	3	1	1		8	3	2	2	2	1	8	8		.6	4	6	7	3	.3	.9	.2	3
Angulogerina angulosa		7										1	1	2							2	2	9	2	2	4			.3									8	1	1	2											4		.2	
Astrononion stellatum		2										.5	2	.5							2	4	3	.9	3	2										1		.4	5	3	2			5		1		2			.4	.3		.5	
Bulimina aculeata																						.3							1										2	1	2											.1			
Cassidulina algida		20										4	30	2							10	9	19	3	4	2			.3							44	79	48	8	10	3			2	2		5	.4	.6	.7	.8	3	2	3	6
C. islandica var minuta		1											.6												3															2					2							.9		3	.7
C. norcrossi																					.9		.4	3																	3							.1							
Cibicides lobatulus		21										3	45	9							7	38	38	5	33	.4										41	13	10	3	6	2			2	6		22	9	3		1	12	5	10	12
Discorbis columbiensis																																													2				6			5		7	1
Eggerella advena	6	9	1	1	1				7	6	2	17	4	17	3	1	.3	3	.4	1	12	5	6	11	4	2				.3		.3	.2			3		5	4	3	2			60	52	85	20	53	60	62	60	42	54	31	26
Elphidium articulatum		1												.3												.4												2						3				3	6	1		3	2	6	4
E incertum var. clavatum		13										1	2								3		.9	3														.8						2	2		7	6	7	1	4	3	9	4	6
E. subarcticum		9										1	4	5							2	2	1	2	.8											3	4	.8	.4	.7	1			8	16	1	23	10	11	10	5	6	4	7	9
Eponides frigidus		8										4	6	2							6	12	7	5	1	3										2	.2	1		5	5			4	3	1	3	1	1	3	8	7	6	9	9
Globobulimina auriculata		8										.6									.8	2	4	3	3	1			2										1	9	2											1			1
Glomospira gordialis						1							1	3										.3	.3					3			2							.7														2	
Haplophragmoides bradyi									4						.2		2	3	1	4				.3	3	4		6	5	6	17	9	2	17	13				9	1	3	15	6												
H glomeratum	15	1	23	19	28	20	11	11	24	17	29	24	3	26	20	23	18	37	13	17	18	9	7	35	21	39	24	21	23	27	13	19	17	18	18	5	2	4	31	26	32	26	15	5				.1				4	4		
Hyperammina elongata					2		4		.4	3	7				5	.3	9	.3	2	4								8	3	7					9							4													
Labrospira crassimargo	5	5	13	8	13	7	17	16	8	16	9	5		4	8	8	10	6	20	8	2	1	6	8	6	3	14	9	9	8	11	8	7	17	8	5	7	10	2	5	2	7	7	3	8			1		4	4	1	1	7	2
L jeffreysii			2	2	1	1	5	9	4	9	1	2		3	2	1	5	3	9	7	8	2	1	3	3	1	2	3	2	3	3	3	2	5	2	.5	.5	8	1	3	1	3	6						9						
Lagena		1										7	2								1	1	9	1	3	.7										1	.5		9	.7	.3							.1	6		.8	.6	.7	2	1
Miliammina fusca																																												.5			.3		3						
Nonion labradoricum		1										3	.3	.3							2	1	1			1			3										2	2	3														.3
Patellina corrugata		2																				.2			.3																														
Proteonina atlantica	7	1	12	18	10	6	6	5	16	16	26	12	3	21	23	16	32	19	17	11	17	2	2	10	5	12	13	12	22	23	10	8	7	15	15		2	15	13	12	9	8	8	16	5	5	14	16		16	13	12	11	10	8
Pseudopolymorphina novangliae																							4																					3			6		3						
Quinqueloculina frigida	1		3						.7		2				2		3																															.1							.3
Q. seminula																						.2				4			.3												3								9		8				
Recurvoides turbinatus	2	.2	2	1	1	1	1	.8	3	1	4	4		2	5	9		4	2	3		5		6	4	6	10	16	11	9	9	11	10	8	13				1	7	3	13	24									1		2	
Reophax arctica	3		1	3		1	2	3	2						2	1	2	1		8		2					1	2		7	1	8	6	5	2						1	1	2									1	2		
R curtus	14	2	15	19	18	16	38	33	15	22	15	2			7	14	6	10	25	30	9			6	6	7	9	9	9	6	28	29	37	10	6				1	1	6	16	20	8			6			4	4	2	4	2	
R scottii	21	1	4	11					1	1		2	3	3	1	2	6	9	2	4					3		3	5		3	8	5			4						3	6										.2	1	2	2
Spiroplectammina biformis	13	8	9	9	9	15	9	9	13	7	5	3		3	5	9	9	7	4	8	3	3		1	8	5	7	6	2	7	3	4	9	5	7				4	3	5	2	6	2	8		3	9				2	2	2	7
S typica		.2	1					8	4		7	1		1		3		2		2	2	3		1	3	4			4	.3								4	2	2	2	2		3		3					1	1	7	2	1
Textularia torquata	11	3	11	11	10	20	8	11	11	15	4	9		3	25	20	13	6	5	6	2	2	.4	1	2	11	14	8		5	5	5	4	2	7				2	1	7	5	4					1		4	8		9	7	1
Trochammina advena							4											6								.4	3	8	3				2		4				.9	4	6														
T. quadriloba				.3								.1																5		3	.3	8	.2	7						4	6														
T squamata	3	7	1	1	2	5	.4		4	2	7		6	2	.7	3		.6	4	8	.4	2			8	4	1		.3				.8	2	.9				1	5	1	.2		3	8	1	3	.3			.4	.3	5	7	3
Valvulina conica																		3		4			.4			1			1	3					.4				.2	2	6														
Virgulina complanata																						.3																	2	1	2														
V fusiformis		4										.5	3	1							2	2	9	1	2	1												4	7	5	1			3	8		1	5	3	7	2	.7	1	6	2

Table 4. Occurrences of Foraminifera species at stations 196-337

STATION	338	339	340	342	350	353	354	355	356	363	372	374	376	378	380	382	383	384	385	386	388	389	390	391	392	393	395	397	402	404	406	408	410	420	439	451	453	466	472	474	478	480	482	486	494	496	506	507	508	512	516	520	521	522	523
DEPTH IN METERS	42	50	56	34	30	32	32	30	29	21	21	27	27	31	34	37	37	35	36	35	35	35	37	36	28	26	21	20	22	20	17	12	9	11	23	25	20	56	38	58	87	73	97	118	144	152	148	137	128	100	88	59	69	79	84
TOTAL BENTHONIC POPULATION	1056	5248	5920	3336	4336	3723	3344	1000	1686	99	417	292	6	244	2064	1280	1118	15144	1676	81	37	10880	2440	1684	195	546	1344	1136	102	3332	844	208	58	105	13440	10	19840	5280	455	363	294	640	578	418	390	569	1104	760	701	1014	4360	332	252	311	183
BENTHONIC SPECIES IN %																																																							
Ammobaculites cassis		.6								1								.6					3															.3		1	7											3	.8		
Ammodiscus ssp.	4		5	.5	.7		1	2	13	8	3	1		4	4	4	2	3	.5				3	5	1	3		.4	12	.2		1			2		3			.3		.2	3	.5	2	1	1	2	2	1		1		6	1
Angulogerina angulosa	4		5					.4											.7			1		7														6	4												.2				
Astrononion stelliatum		3	1			3	2				2							2						2			4			1	.2							3	1												.2				
Bolivina pseudo-plicata				.2	7	3	2				2																.1	.4		.5		.5																							
Buliminella elegantissima				.7		2					2	3		4													.1																												
Cassidulina algida	8	2	10	6	10	9	2	3	1	1	1	1		.8	3	6	3	2	6		11	13	6	4	3	4	2	2			1		2		15		4	3	20												2				
C. islandica var. minuta	.8		.5	1	7	5	7	1	.9		.2	3		.4		3							.7			1				1	.5							6	7																
Cibicides lobatulus	10	3	7	24	17	27	9		1	1	3	.7	17		9	19	17	.6	9	85	76	15	17	5	23	34	8	58	14	5	5	8	3	63	31	90	79	9	36												.4				
Discorbis columbiensis	2			2	.4		2	.8			2	3								6			1		5	.4	1		1	1	2						.3					.2													
Eggerella advena	27	46	38	19	18	16	50	51	41	22	36	49		67	36	25	43	57	54	4	5	24	24	30	26	16	42	5	17	52	11	38	40	8	4		2	30	1	24		.2	.3			.7				.3	3	24	21	5	4
Elphidium articulatum	1	1	1	1	2	9	.7		.2	3	2	.3				3	3	.2	1				1	4	2	3	14			4					2			.6	.7												.2				
E. incertum var. clavatum	8	3	4	12	17	16	5	7	2	20	8	3		2	1	3	2	.8	4	2	5	14	6	5	15	16	9	22	11	23	48	20	22	13	23		5	4	11												.6				
E. subarcticum	5	2	4	8	8	9	7	8	11	18	17	22	33	3	17	8	33	1	5		3	4	8	7	9	14	1	3	20	5	29	14	24	1	14		6	10	9												.2				
Eponides frigidus	12	7	8	10	4	3	8	8	2	1	2	2		3	1	1	4	.6	6			13	9	9	6	2	7	4		2	2	4			3		1	6	3												5				
Globobulimina auriculata		.3	1				1											.2																				.3	2		.7	.8		1							16				
Haplophragmoides bradyi																																													1	16	5	6	7						
H. glomeratum			2												.8				.5									2										3		5	14	22	23	32	31	23	16	19	20	29	18	3	10	12	6
Hippocrepina indivisa																																								1			3									.3		.3	
Labrospira crassimargo	8	.6	3	7			1								.4	.3		.3					3		.6		6	.7			.2					10		4	2	3	9	12	18	6	10	9	10	21	16	5	4	3	4	5	6
L. jeffreysii																																								.3	3	.5	2	7	3	3	1	2	2	3	.7	1	.4	.6	.5
Lagena	1	.9	5	1	.7	.3	.6	.8	7					.4		.3			.5				.6	7	1	.4	.9			2	.2				1		.3	1	1												.4				
Miliammina fusca									8																				2	.5	.5																								
Miliolids				2	4		2	.8	.8		.7			.8											2		4	.4	12					4	.4		.3																		
Nonion labradoricum	4	.3				.2																																.6	.2			.3		.5							15				
Polymorphinidae				2			.1			1							.2																		.2		.3																		
Proteonina atlantica	11	22	7	7	7	4	8	1	3	23	9	14		18	4	11	11	21	9			13	12	24	2	5	8	3	1	4	2	1	3		2		.3	17	3	7	41	29	9	17	22	17	14	19	29	24	22	10	13	11	1
Pseudopolymorphina novangliae					.4						2	.7				.3			.2			.6	.3			.4	.6								.2				.9																
Quinqueloculina arctica	4			.5		.2			.1							.3				1				.5										6	.2		.3	.3	.4																
Q. frigida				.2			.1					.3				.6							.7									.5							.4	.6															
Q. seminula					.4	.2		.4	1		1	1							.5						.6				1			.5		6																					
Q. subrotunda				.2	.4			.4	.5						.4			.3								.7													1																
Recurvoides turbinatus																								2														.3		.3	3	2	8	2	8	9	12	5	2	3		.6	2	1	1
Reophax arctica					4				.1									.2																								.9	1	2	1	.7	3	.7	.9	2		.3		5	2
R. curtus	8	.6	1	1			.6		.1						1	.6	.9	3						1				.4										.3		9	8	4	19	4	7	8	31	18	8	6	4	15	9	4	11
R. scottii	8	.9	.5	.2	4	1			3		3	1		.8	2	.3		.5					3	1								2			.5		.3	.3		22	7	.8	1	.5	1	1		.4	2	2	7	4	4	19	33
Spiroplectammina biformis	1	.9	4	5		7	1	.8	.2		.2			.4	.8	.3	7	4	.2				1	2			.3											2	.2	14	2	7	7	12	8	5	3	4	6	11	2	12	9	12	11
S. typica	8		.5	.5	.4	2	5		.1		.2	.3		.8				.5	.2			2	.3	5								5										.3		.5								4	2	1	2
Textularia torquata	4	.6	2	.7		.7	.2	.4	.2		.2				4		1	1					.7	5			.1			.1		.5						2	.2	8	10	17	9	13	5	4	3	3	3	12	3	19	16	16	16
Trochammina advena																																											3	.5		.5	.3			.6					
T. lobata	3	.9		1		3	.1				2	1		.4		.3	.4	4	2				1	4	.6	.4	2	1				.5	2					2	.4																
T. squamata	.4	2	3	.5	4	3	.4		9		3	1	50	1	13	16	4	1		1							.1		6	7		2			.5			.6	2	4		.5	1			1				.6	.6	2	7	8	4
Virgulina fusiformis	2	3	2	1	2	6	1	2	1		3					.3	1	1	.2				2	.5	.6		.1	.4	4			4			2		.3	1	4												1				

Table 5. Occurrences of Foraminifera species at stations 338–523

STATION	525	526	528	529	530	531	533	534	535	540	541	543	544	552	554	556	558	560	562	564	566	569	572	573	575	577	580	585	587	590	591	592	595	598	600	601	602	604	606	607	610	614	618	621	623	625	626	629	632	634	642	644	645	647	648
DEPTH IN METERS	85	97	96	105	110	113	128	134	140	170	170	169	170	37	34	49	70	84	93	93	100	116	143	137	158	158	171	158	142	96	96	105	160	168	167	78	46	51	40	27	37	56	77	90	82	111	120	140	152	152	119	100	116	139	142
TOTAL BENTHONIC POPULATION	290	247	287	717	541	775	483	578	505	262	885	442	565	372	218	11040	3056	1400	225	322	654	774	291	632	1263	544	330	717	701	2008	203	7420	452	690	1569	314	304	3642	5648	42	10400	1176	864	1251	924	972	466	1059	706	1318	2915	1092	1498	2284	281
BENTHONIC SPECIES IN %																																																							
Ammodiscus ssp.	3	1	1	.4	.2	3	1	2	2	.4	1	3	3	.3		3	.3	3	2		.3	2	.7	2	2	3	1	1	.7	1	1	1	3	3	2	2	1	.2			.5		2	.2		.1	1	.8	2	2	.7	.4	.4	1	1
Angulogerina angulosa																6	.3	.3												.4		.5						.2	.3												.2			1	
Astrononion stellatum																6	2													.4		2						.2	.9		.5										1			3	
Cassidulina algida														17	6	23	4	5												62	45	38						6	12	5	6	20									32	59	70	16	
C. islandica var. minuta															.5		.5	1																					.3			2												.2	
Cibicides lobatulus														51	40	22	9													14	40	11						7	22	74	18	42									10	33	17	12	
Crithionina pisum var. hispida					.2						.3																						.9																						
Eggerella advena	3	2	.3	.4						.4		.9	.7	1	5	12	1	7	.4		.6					.7		2	.7	6	2	3		.6	1	7	21	32	20	5	23	8	5	2							6	.4	1	6	4
Elphidium articulatum														.5		6	.3	.6													.5							.3	.3		7	1													
E. incertum var. clavatum														15	31	7	3	.3																				2	9	9	13	10									.2		.1	.2	
E. subarcticum														7	5	6	3	3												3	6	3						3	11			5									.9	3	3	.7	
Eponides frigidus														3	5	7	2	4												2	1	1						5	6		5	6									2	1	1	9	
Globobulimina auriculata																.6	4	11														.3						2	.3		.2	.3											.1	.7	
Glomospira gordialis													.2				.3												.6								.3																.1	.2	.4
Haplophragmoides bradyi			.3	.7	.7	1	4	6	4	5	4	4	13								.3	2	6	3	9	10	6	9	8			.3	7	4	23										.3	.5	16	5	10	5					3
H. glomeratum	19	17	29	23	15	21	27	21	24	32	16	9	15			2	12	21	6	23	20	18	25	27	20	19	28	18	22			12	16	16	12	11	9	3	.1				9	17	28	31	18	27	27	10	15		.4	23	23
Hyperammina elongata			.3	.6	1			1	.4				1							.5		.1			.5	.7			.4				.4	.3												.3	.6	.3		.2					.4
Labrospira crassimargo	8	3	9	10	13	8	9	5	10	8	5	5	6		2	1	5	4	7	8	9	10	6	6	6	3	8	12	11	6		5	4	6	11	9	2	1	1		2	2	3	8	8	13	12	10	9	9	2	1	3	3	4
L. jeffreysii	.7	4	2	2	7	5	3	4	3	3	4	4	3				.5	6	1	1	.6	5	1	3	3	3	2	2	3		2	.8	8	2	4	.6	.3						.7	4	.6	.6	1	2	4	2	.3		.1	2	6
Lagena														.5	1	2	.3	.3												.4	.5	1						2	1	2	2										.7		.1	1	
Miliolids																.3	.5															.5							.1	2	2													.2	
Nonion labradoricum																.6	3	12																				2	.3		.2										.2			2	
Proteonina atlantica	7	6	33	30	22	20	22	15	18	17	6	6	6	2	2	7	14	7	3	15	31	17	27	15	10	6	7	10	12	3	.5	14	12	8	8	1	6	11	3		5	.7	2	6	30	37	25	23	11	7	20	2	1	7	16
Quinqueloculina frigida			.3		.6																.6																				.5														
Recurvoides turbinatus	2	1	3	2	6	6	4	12	6	4	14	9	6			.3	3		2	2	1	7	1	9	14	16	10	10	12			.8	8	19	10	3	1	.5			.2		1	4	.3	.6	2	8	14	26	1			4	2
Reophax arctica	2	4	.7	1	4	2	1	2	2	4	1	2	.2					.9	3	1	1	2	1	2	.2	1		.4	1				2	.3	1	.3	1	.2					1	.5				.3	1	.2					.4
R. curtus	20	20	10	8	20	12	9	12	20	6	25	48	16			.6	4	2	38	25	8	8	9	14	29	20	22	23	9			.8	26	30	19	13	5	.4	.1		.4		7	16	1	3	3	12	8	30	.4	.4		.9	8
R. scottii	8	8		.6	1						2				.9		7		15	5	1	3	6	2	.7	2	.6	2	3				2		.6	17	14	2	3		.7		35	15					.3	.8					3
Spiroplectammina biformis	9	18	4	12	7	10	9	7	6	9	12	5	22		.5	2	9	10	10	6	13	10	8	8	4	7	8	5	4				6	7	4	10	16	7	2		2	1	17	17	6	4	7	4	8	3	3			1	5
S. typica	3	8	.7	.4												3	.5			.5								.4								.3		1					.7	.7	.6	.3					.2			.9	
Textularia torquata	19	18	5	11	9	9	9	9	4	3	8	2	.7	.5		.3	9	7	12	9	10	15	6	5	1	5	3	3	5			.5	4	1	2	21	18	7			.7		11	10	6	8	11	4	4	2	2			.9	11
Trochammina advena			.3	1		.6	6	7	6	3	1										.3	.1	1		.5	2	3		.3			.5	.4	.3	.2										.3	.2	.4	.3	1	.5				.4	.4
T. lobata														.3																		.8						.2	1															.4	
T. quadriloba						1		.7	4	1	1		2				.3					.5			.2	.4			.4					.3	.2	.3									.3	.1	.9	.6		.3					
T. squamata	3	1						.3		4	.3	.9	1	.3		6	2	1		2		.1		2		.4	.3	2	6	1	.5		.9	.6		2	5	5	1		1	3	5	1	16			.3			.9		.8	.2	13
Valvulina conica			.3						2	5			2										.7						.4																		.2	.3	.3					4	
Virgulina fusiformis														.5		3	2	9												.4		1						2	5		5										.2			9	

Table 6. Occurrences of Foraminifera species at stations 525–648

STATION	649	653	654	656	658	660	662	663	664	665	666	667	668	676	678	685	686	691	697	702	703	706	707	708	718	721	722	723	724	725	726	727	728	729	730	731	732	733	734	736	738
DEPTH IN METERS	150	168	181	152	145	126	125	118	111	102	92	75	76	37	40	128	150	152	146	110	107	61	27	18	130	34	134	136	150	150	150	142	133	138	144	122	113	13	110	97	76
TOTAL BENTHONIC POPULATION	515	284	483	351	683	1120	583	720	583	312	327	406	6184	189	554	5360	424	873	397	2120	280	5180	2840	28544	1372	4430	284	340	770	828	676	177	714	510	762	263	337	495	283	1000	552
BENTHONIC SPECIES IN %																																									
Ammodiscus ssp	2		2	6	1	9	9	2	9	3		2	6	5	4	4	9	1	4		1		3		6	5	1	3	3	2	3	1	.8		1	2	6	2	1	.8	
Angulogerina angulosa													4	2		2				4		2			3	2															
Astrononion stellatum													2			9				1		.2			3	2															
Bolivina pseudo-plicata																							3																		
B. subaenariensis																																									
Bulimina aculeata																1				4						1															
Cassidulina algida													6	24	17	4				4	7	1	2	14	2	4														2	28
C. islandica var. minuta																.1				4																				4	
C. norcrossi																4										5															
Cibicides lobatulus													1	29	76	2				3	1	2	66	73	2	1														14	66
Eggerella advena	1		2	.3							6	1	10	26	4	6	5		2	1	4	9	8	9	9	2	.4		.1							.4		.4	3	4	
Elphidium articulatum													1		6								.3	.4	1																
E. incertum var. clavatum													2	4	5	1				8		2	3	7	6	5															
E. subarcticum													.2	2	3	.9				2		.4	2	2																.8	.7
Eponides frigidus													.6	3	2	5				6		2	.6		3	4														4	1
E. wrightii															.7																										
Globobulimina auriculata													1			.6				7	4	4			3	16													.4	2	
Glomospira gordialis	2		4					8					2									1						.6				.6					3		4		
Hoplophragmoides bradyi	4	4	3	6	20	5	1	6	3	3	3		2			2	6	4	8	8		.4			.6		2	2	1	4	4	9	13	3	9	3	9	7	5		
H. glomeratum	15	29	9	25	5	26	23	23	21	30	20	18	38	4		37	22	18	13	27	24	34	.3		35	19	11	16	9	13	17	14	22	25	19	29	24	27	41	34	2
Hormosina sp					.3																								4												
Hyperammina elongata	4	4	8	1	1	4		3									5		3								4		4		3	1	1						.4		
Labrospira crassimargo	13	7	5	10	11	11	12	9	7	4	4	6	8	1	1	2	24	17	18	1	9	3	3		5	2	23	25	4	9	5	12	15	9	14	18	6	16	5	2	.4
L. jeffreysii	3	3	3	1	3	1	4	3	5	4	3	2	8	1		2	1	2	3	1	3	2			6	2	12	4	2	5	2	2	6	4	3	1	1	1	2	8	2
L. cf nitida	.2																													4											
Lagena													2		7	9				8		4	6	4	3	7														2	.4
Miliammina fusca															.7																										
Miliolids													4			3				1			8	8		9														8	
Nonion labradoricum													2			2				12	3	.8			5	19															
Proteonina atlantica	12	5	17	27	21	15	21	15	27	17	20	15	17		1	11	7	17	13	8	25	21	.3	.4	22	18	8	8	6	7	9	34	26	29	18	26	3	27	12	6	
Quinqueloculina frigida												2			4															2											
Q. seminula															4																										
Q. subrotunda																				4			14																		
Recurvoides turbinatus	6	.1	6	7	5	6	6	6	3		3	1	2	2	7	6	3	15	5	4		4			1	1	7	9	6	11	15	9	10	11	9	7	4	5	7	2	
Reophax arctica	3	2	1	3	6	2	2	2	1	1	4	2	2				1	2		4	4						1	2	2		2	6		4	5			2			
R. curtus	12	2	12	4	10	10	7	2	2	5	5	14	2		2	.3	9	11	20	8	11	1			3	7	21	16	53	37	28	1	6	3	18	5	1	4	1		
R. scottii	5	2	1		6	2	7			3	10	10					4	7					8							4							3				
Robertina cf charlottensis																3					4	2																		4	
Spiroplectammina biformis	8	.2	6	3	3	8	8	9	11	2	13	8	3	5		6	10	8	8	5	11	3		.4	3	1	9	8	7	5	6	2	2	7	3	4	16	5	5	3	
S. typica													6			1	.9			3	7	3			3	1	7	6	1	4	.3							8	1	7	
Textularia torquata	10	4	2	1	4	10	12	8	10	17	15	15	3			7	5	2	2	5	5	6	.3	.4	2	.9	4	3	6	3	7	.6	1	7	3	1	17	1	12	2	
Triloculina tricarinata																																									
Trochammina advena	.2	4	4	2	2	2	.2		1	6	.6					4		3	5		2					2			4	4		2	3	2	3	2					
T. lobata														5		4									6																
T. quadriloba	4	4			4	2	.2	3	.2				2			3		7				4					.4	2	1	2		1	3				1	1	1		
T. squamata	4	3								4	3	6			12	1	3	1		8			3			.2		.3		4	6		.3		.5		1		1	1	
Valvulina conica	.8	1		2	1	.2										.1	.5					.4			1			.3			.3	.6	1		1	2	.3	.6	1		
Virgulina complanata												2			1				1		2			.6	.9															4	
V. fusiformis												1			6							.6			5															2	

Table 7. Occurrences of Foraminifera species at stations 649–738

STATION	2	5	8	14	18	21	22	23	25	27	28	29	30	31	33	34	41	42	43	48	52	53	54	55	58	61	62	65	67	68	71	73	76	80	82	85	88	90	91	96	98	102	103	104	105	106	107	110	111	112	113	114	116	118
DEPTH IN METERS	110	106	148	129	144	172	162	152	143	104	157	175	208	160	122	95	107	108	118	95	107	110	119	125	143	158	162	168	172	171	180	183	166	152	146	114	100	93	66	88	96	117	110	109	108	107	105	99	98	96	94	93	87	90
TOTAL LIVING BENTHONIC POPULATION	22	2	72	14	62	14	90	57	63	146	79	12	68	82	316	20	35	45	21	2	39	113	80	67	24	40	22	48	56	14	50	50	26	48	49	12	44	40	9	5	24	16	49	14	3	15	74	13	42	15	28	14	18	10
BENTHONIC SPECIES IN %																																																						
Ammodiscus ssp				7				3		1	1							2			5	9	2	1		4					2			6	16						4													
Cassidulina norcrossi										4																																												
Crithionina pisam var. hispida																																																						10
Eggerella advena																																							11												7		11	
Haplophragmoides bradyi			4	7			3	63		19					1						5	11	2	3		7				14	6	18	4	6																				
H. glomeratum	5		8		16	14	17		19	8			18	15	8		3	20		50	20	16	12	22	8	18	9	8			14	10	11	19		17	24	2	22		33		4	7		20	13	8	10	20	29	29	44	
Hormosina sp.																			5																																			
Hyperammina elongata					2					3														3									8		2																			
Labrospira crassimargo	41		8	43	24	71	13	21	12	15	25	17		5	13	20	14	11	24		15	3	5	1	4	7	18	21	7	43	16	8		6	2		10			60	12	12	6	21	33	7	5	23			7			10
L. jeffreysii				14	2					1	5	50			2	20	23	7	9			9	2	3			9				2	18						5									3							
Lagena																		2																																				
Nodosaria																			9																																			
Proteonina atlantica	36	50			5			5		18	21		18		8	20	9	18	29		13	7	12	7	12				7		14	18	11	19	14	58	7	40			8					20	3		29	33	21	36	11	
Quinqueloculina frigida																																																8		7				
Recurvoides turbinatus			8		8		7		21	8	18											8	7	4			18	4	14		6	12						5																
Reophax arctica															4																													7			3							
R. curtus	18	50	71	29	40	14	57	7	45	19	24	34	65	78	63	40	51	31	14	50	33	43	47	34	75	55	45	54	64	43	34	16	61	37	61	25	48	47	33	20	25	56	88	36	33	20	49	38	38	27	29	29	11	50
R. scottii																								1																														
Spiroplectammina biformis							3			1	4			2				4			5		2	16		7		4			4						7				8	12			33	13	3	15		13			11	
Textularia torquata					3					1					1							7	5	1				4						6	4		3		33	20	8	19		29		20	22	8	19		7		11	30
Trochammina advena									2		1										3																																	
T. quadriloba																																											2											
Valvulina conica																															2																							

Table 8. Distribution of species of living Foraminifera at stations 2–118

STATION	121	123	128	131	133	134	135	136	137	138	139	141	142	143	144	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	173	175	176	178	181	182	183	184	185	186	190	192	194	196	201	203
DEPTH IN METERS	89	90	76	73	73	76	75	73	73	70	69	67	65	64	61	74	76	76	78	81	80	82	85	82	82	79	76	72	64	67	73	81	86	88	92	100	98	96	87	80	64	73	90	98	92	92	92	99	92	86	76	67	64	89
TOTAL LIVING BENTHONIC POPULATION	8	1	5	3	3	5	1	4	1	5	4	6	9	5	29	1	1	12	3	2	2	4	4	4	1	5	8	57	3	2	12	8	22	9	6	2	13	11	11	28	1	25	9	14	28	29	3	15	6	3	2	28	70	16
BENTHONIC SPECIES IN %																																																						
Ammobaculites cassis															17																																							
Ammodiscus ssp.																																														3								18
Eggerella advena				67						20	25	33		20	17			8								40		2		50	17									4												11		
Haplophragmoides glomeratum	50		60	33		20				60											100		25	25		40	25	12			8	12		33			15		9			12	22	64	11	28		7				45	29	18
Hippocrepina indivisa						20																																																
Labrospira crassimargo	12							75			50							8						25			25	10			8		27	22		50	62	9		4		4			4	7		27	33				14	9
Proteonina atlantica											25			40	17													12		50									9			4	11										6	
Quinqueloculina frigida																																																				3		
Recurvoides turbinatus																																			17								22							33			3	9
Reophax arctica																		8				25									17				17			9														3		
R. curtus	37	100	40		67	40	100	25	100			50	76	40	38	100		17	100	50		75	50	50		20	37	51			8	12	73	22	50		15	27	18	21	100	80	33	21	29	48	100	40	50		50	11	26	18
Spiroplectammina biformis					33	20				20		17	11		3			33		50							12	7	67		8	37		22	17	50	8	36	18	18					25	3		13	17		50	28	20	9
Textularia torquata													11		7		100	25					25		100			5	33		33	37						18	45	54			11	15	32	10		13		67		6	3	18

Table 9. Distribution of species of living Foraminifera at stations 121–203

STATION	205	207	213	215	219	221	222	228	230	231	234	236	239	250	253	254	255	256	259	261	263	265	284	287	474	478	480	482	494	496	506	507	508	512	520	521	522	523	525	526	528	529	530	531	533	534	535	540	541	543	544	562	564	566
DEPTH IN METERS	84	150	109	100	85	78	70	87	99	100	122	122	131	132	143	145	148	152	174	174	174	174	171	162	58	87	73	97	144	152	148	137	128	100	59	69	79	84	85	97	96	105	110	113	128	134	140	170	170	169	170	93	93	100
TOTAL LIVING BENTHONIC POPULATION	24	2	104	35	111	40	79	23	84	36	52	26	54	36	1	11	26	27	69	86	30	24	80	6	8	28	2	6	3	18	45	49	68	84	67	10	5	13	20	12	24	44	70	45	58	22	33	9	42	24	11	36	28	24
BENTHONIC SPECIES IN %																																																						
Ammobaculites cassis	4																																																					
Ammodiscus ssp.	4				3					3						9	8		4	5	3		2									2	1								4	2		17	3		6			8				
Crithionina pisam var. hispida									2																																													
Eggerella advena							2																												24	10				8		2												
Haplophragmoides bradyi																9	8			2	3	25	10							6			19										4	6	3						18			
H. glomeratum	25	50	11	11	19	10	36	22	25	36	58	11	7	42	100	18	23	11	35	21			32	67	37	29		67	67	17	33	20	18	57	3	20	40		45	8	62	41	20	6	17	18	24	22	29		18	3	16	17
Hyperammina elongata																						12								11												2					3							
Labrospira crassimargo	8		23	9	11	10	2	9	9	8		19	18	11		9		33	17	5		25	7		12	7	100			6	27	2	3	4	6				10		8	9	9	17	9	36	18	22	7		9	17	16	8
L. jeffreysii				3	11		4	4		11		15		8						2			2			29			33					7									17	6	2		3				9		5	
Proteonina atlantica	4				5	12	24	35	16	25	4	8	7	14		18	8		4		20		2		12	7				22	13	14	31	14	9						17	14	16		29		3				18		10	33
Quinqueloculina frigida					5		2																																															8
Recurvoides turbinatus				3	5	2					8		11	3		18	23			16	3	12	30			7						8		4					5						5		3	22	29					
Reophax arctica			2	3					2																																									8				8
R. curtus	42	50	52	66	32	50	17	13	32	17	27	46	44	14		9	23	56	30	32	60	12	10		25	21				33	27	49	21	14	45	60	40	46	35	33	4	25	29	33	19	36	36	22	7	75	27	67	37	25
Spiroplectammina biformis	4		10		5		7	4	5		4		11	8		9			4	7	10	12										2	4		7			23		8	4	2	4	6	7	9	3	11	21			3	5	
Textularia torquata	4		2	6	3	12	6	13	9								8		4	9			2	33	12			33		6		2	3		6	10	20	31	5	42		2		6	5				7	8		11	10	
Trochammina squamata						2																																																

Table 10. Distribution of species of living Foraminifera at stations 205–566

STATION	569	572	573	575	577	580	585	587	595	598	600	601	602	618	621	623	625	626	629	632	634	648	649	653	654	656	658	660	662	663	664	665	666	667	688	691	697	703	722	723	724	725	726	727	728	729	730	731	732	733	734
DEPTH IN METERS	116	143	137	158	158	171	158	142	160	168	167	78	46	77	90	82	111	120	140	152	152	142	150	168	181	152	145	126	125	118	111	102	92	75	150	152	146	107	134	136	150	150	150	142	133	138	144	122	113	131	110
TOTAL LIVING BENTHONIC POPULATION	60	21	26	78	20	22	42	25	52	34	99	31	25	75	108	42	26	19	72	22	96	10	12	18	8	7	17	43	10	34	31	4	6	33	38	51	11	33	22	19	39	22	78	10	10	40	28	14	8	16	3
BENTHONIC SPECIES IN %																																																			
Ammodiscus ssp		5	8										4																						5		9						8				7	7		6	
Crithionina pisam var hispida									8																																										
Eggerella advena												6		4																																					
Haplophragmoides bradyi				11	10	9	21		8		21						4	10	12		2			6		29									5		27									10	14				
H. glomeratum	15	38	23	11	10	36	36	28	4	6	21	39	20	28	25	43	8		17	36	4	10	8	39	12	14		24		18	16	25	16	45	16	18	9	33	9	16	15	18	8	20		20	7	36	25	56	
Hormosina sp											9																6																								
Hyperammina elongata				4																							6														3										
Labrospira crassimargo	8		8	15			14	12	4		15		4	4		7	38	15	8		29	10	50	22	12		18	18	10	29	10			9	47	24	9	6	14	5	5	27		20		5	7	21	38		
L. jeffreysii	20			4				8	11	18					14		4		4	9											6												3			10	7				33
L. cf. nitida																					2																														
Proteonina atlantica	17	24	15	8				8	8	12	6		8	8	14	21	19	31	17		4	10	17	6			53	12	50	12	10	25	50	3	5	12	27	14			3		10	20	60	25	7	7	12	12	33
Quinqueloculina frigida																																		3																	
Recurvoides turbinatus	3		8	8	10		21	28	15	12	6	3			3	7	4	5		18	35	10		6	25	14		6		6									5		3		13			10			12	6	
Reophax arctica															3													6																							
R. curtus	23	19	23	35	50	45	7	8	31	53	21	42	48	32	39		8	36	38		19	50	25	6	25	43	18	18	30	12	39	50	33	33	5	35		20	32	63	46	27	26	20	20	10	36	7			
Spiroplectammina biformis		9	15	4	20	9						3	16		3	7	11		4	18	4	10		11	25				10	12	10				16	6	18	9	27	5	18	18	5	10	20	5		14			
Textularia torquata	13	5							11			6		24		7				18				6				6		12	6			6		6		9	14	5	8	9	28			5	7	7		6	
Trochammina advena																	4											6			3																				
T. quadriloba																																								5										12	
Valvulina conica								8																																									12		33

Table 11. Distribution of species of living Foraminifera at stations 569–734

Table 12

Foraminifera species found living, listed in decreasing order of abundance.

Species	*No. of Stations*
Reophax curtus	182
Haplophragmoides glomeratum	160
Labrospira crassimargo	142
Spiroplectammina biformis	111
Proteonina atlantica	106
Textularia torquata	98
Recurvoides turbinatus	67
Labrospira jeffreysii	49
Haplophragmoides bradyi	44
Ammodiscus	42
Crithionina pisum var. *hispida*	16
Reophax arctica	14
Hyperammina elongata	12
Eggerella advena	10
Quinqueloculina frigida	7
Trochammina advena	6
Valvulina conica	4
Trochammina quadriloba	4
Hormosina sp.	3
Ammobaculites cassis	2
Trochammina squamata	1
Labrospira cf. *nitida*	1
Lagena	1
Nodosaria	1
Cassidulina norcrossi	1
Hippocrepina indivisa	1

STATION	2												9										26									
DEPTH IN METERS	110												143										110									
SAMPLE	2	3	4	5	6	7	8	9	10	11	12	13	1	2	3	4	5	6	7	9	11	12	1	2	3	4	5	6	8	9	10	11
POSITION IN CORE IN CM. FROM TOP	4-8	8-12	12-16	16-20	20-23.5	23.5-27	27-31	31-35	35-39	39-43	43-47	47-52	0-2	2-4.5	4.5-7.5	7.5-9.5	9.5-14	14-17.5	17.5-20	23.6-26	28-31.5	31.5-35	0-4	4-6.5	6.5-8.5	8.5-12.5	12.5-15	15-18	21-24	24-27	27-30	30-32
TOTAL PLANKTONIC POPULATION			10			15			12	9	16	9					1															2
PLANKTONIC SPECIES IN %																																
Globigerina bulloides			80			100			33	100	75	33																				100
G. pachyderma			20						67		25	67																				
G. sp.																	100															
TOTAL BENTHONIC POPULATION	771	662	508	677	955	579	872	363	792	1307	1600	1164	187	104	68	63	174	166	55	64	125	77	125	215	324	448	278	334	208	264	128	262
BENTHONIC SPECIES IN %																																
Ammodiscus ssp.													2		1								.8	.5		.7						
Angulogerina angulosa																										4						
Astrononion stellatum		3	2	.9		.5	.5	.2											2									.6				
Bolivina pseudopunctata									.5	.5		.3																				
B. subaenariensis								.8			.3						3	7			2				.6	3					2	.8
Bulimina aculeata																	7	14	7						15	13	.7	.6				
B. marginata		.6	4			.5	.5			7	1	7																				
Cassidulina algida		1	1	.5		1											1	1	2	2	6				2	3	3	4	5	6	3	5
C. islandica var. minuta		.6	2	8	4	7	7	3	6	6	8	24						.6										.6				
C. norcrossi		.9	9	13	9	12	16	12	14	34	22	28					3	6	5						.6	1	1	5	1	3	2	.8
Cibicides lobatulus									.5									.6	2						6	7	1	1		.7	.8	4
Cornuspira	.4	.3																														
Eggerella advena													.5										2	.9								
Elphidium articulatum																		.6														
E. incertum var. clavatum			5	3	1	8	8	2	4	2	.8	1						.6										1		2	.8	2
E. subarcticum																										1	2					
Eponides frigidus		1	5	6	2	3	2	.8	1	.2	.8	.8														.7		.6	2			
E. umbonatus												.8																				
Globobulimina auriculata		12	18	16	31	19	18	21	9	8	5	5					9	28	27	2	26				3	19	30	27	10	24	19	30
Haplophragmoides bradyi			4										4	9	1	5	.6						.8	6	19	4		.6				
H. glomeratum	38	17	2	2	.5								20	15	62	38	20	5	13	42	6	38	30	29	17	3	2		1			
Hyperammina elongata																							.8									
Labrospira crassimargo	14	13	.4										26	37	13	27	14	2	11	8	5	19	17	30	13	8	1	2				
L. jeffreysii	1	.9				2							2	6			1			5			2	2	7	.4						
Lagena		.9	4					.8	.5	.9	1	1						6								1	.7	.6			.8	
Nonion labradoricum		11	39	28	26	26	24	31	27	20	26	11					16	25	18		29				2	22	31	26	25	38	21	29
Nonionella auricula						.5		.8	.5																			.6				
Proteonina atlantica	39	37	14	16	23	8	16	12	10	9	5	2	19	18	6	25	21	7	9	33	20	38	42	24	12	15	25	26	54	23	44	25
Pullenia bulloides						3	.9	.8	2	2	3	.5																				
Recurvoides turbinatus													18	10	12	2	2			6	5	3	2			.7						
Reophax curtus	4	1	.8	1		.5	.5						10	5	4	4	.6	6	4	2	2	3	5	4	1	.4		.6	1	.7	5	.8
Spiroplectammina biformis	3	.6	4										.5							2				.9	.6	.4						
Textularia torquata	.4																															
Trochammina advena																							.8	1	4	.7						
T. lobata													.5																			
T. squamata																							.8						.5			
Virgulina complanata				1	.5	.3	4	7	20	15	22	13					.6															
V. fusiformis		.3	.4	3	1	6	2	7	3	.9	2	4																				

Table 13. Distribution of Foraminifera in cores 2, 9, and 26

STATION	27											47														68								
DEPTH IN METERS	104											96														171								
SAMPLE	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11	12	13	14	2	3	5	6	8	10	11	12	13
POSITION IN CORE IN CM. FROM TOP	0-3	3-7	7-11	11-12	12-13	13-16.5	16.5-19	19-21	21-24.5	24.5-29.5	29.5-32	0-3.5	3.5-7.5	7.5-11.5	11.5-12.5	12.5-14	14-15.5	15.5-17	17-20.5	20.5-24	24-28	28-32.5	32.5-36.5	36.5-41	41-44.5	7.5-10.5	10.5-14	13-14.5	20-23	26-27.5	31.5-34.5	34.5-37.5	37.5-40	40-42.5
TOTAL PLANKTONIC POPULATION			3	2	8	15	16	56	9		24							8											5					
PLANKTONIC SPECIES IN %																																		
Globigerina bulloides						60	75	57	100		100							100																
G. eggeri						20	12	29																										
G. inflata						20	12	14																										
G. sp.			100	100	100																								100					
TOTAL BENTHONIC POPULATION	98	116	213	82	270	760	348	2354	438	1012	812	172	378	265	198	244	296	240	488	201	438	960	408	672	394	78	63	165	245	47	99	105	139	42
BENTHONIC SPECIES IN %																																		
Ammobaculites cassis												6																						
Angulogerina angulosa								3																								1		
Astrononion stellatum					1		.5		7							2			.8									2	.4	2				
Bolivina subaenariensis																										1				2				
Bulimina aculeata			1				2						.8	1							7	3		1		1			.4	4				
Cassidulina algida			1			3		.3	5	2		6	2	1	4	7	3		4	15	7	2	3	1	1	1			8		1		4	
C. islandica var. minuta			4	7	21	14	8	8	11	16	12													6	2			15	8	4	4	9	14	
C. norcrossi			17	40	39	41	36	33	38	32	8		8				1			4	8	32	1	8	17			31	41	17	18	28	6	5
Cibicides lobatulus			3		1		3	3	2	1	1										7							2	8					
Eggerella advena	4	3			7		5					6																				1		
Elphidium articulatum																2																	7	7
E. incertum var. clavatum				2	3	4	2	4	2	5	10		8	4		2			2		1	3	2	6				39	12	2	60	50	42	69
E. subarcticum						.8	5	3	7						1						7										4		7	
Eponides frigidus			1	7	6	11	9	8	3	7	19		2	4	6	5	1	3	4	4	4	7	7	4	9									
Globobulimina auriculata			22	12	6	10	9	7	14	8	5	28	55	39	55	59	46	39	61	34	45	33	48	39	39	13	6		5	13				
Haplophragmoides bradyi	2																																	
H. glomeratum	28	21	3									24	3	8	3		3		8	1						3	8							
Labrospira crassimargo	5	21	6									10	8	6	4	2	4	18								4	29							
L. jeffreysii												6		1		2																		
Lagena			3	2		1	3	.7	1		2	6		1	1		4			1	2	2	1					.6			1			
Miliolids																				6													7	
Nonion labradoricum			17	14	8	5	14	28	13	22	32	3	25	25	10	16	30	21	21	22	20	13	20	23	14	6	6	4	24	28	8	10	30	19
Nonionella auricula						1	2	5		8	2																		4					
Proteonina atlantica	36	46	15	12	3	1	2	2	3	3	5	12	6	3	6	5	3	10	3	3	6	5	9	11	11	69	43		2	26				
Quinqueloculina seminula										4																								
Recurvoides turbinatus	1		1																							1								
Reophax curtus	2	2										11	2	1				3		3	7	3					4			2				
Robulus																							2			1	5	4						
Spiroplectammina biformis	2	3	1									5	8																					
Textularia torquata	16	3										1																						
Triloculina tricarinata						8	1																											
Trochammina squamata	2		3		2	.8		1			5	2																	.4					
Virgulina complanata					3	3	3	2	4	2	4	6	2	2	3		4	3	2					6				2	2		4		7	
V. fusiformis														2	3				.8	4	1	2	1	6	6									

Table 14. Distribution of Foraminifera in cores 27, 47, and 68

STATION	77											91														130					
DEPTH IN METERS	164											66														69					
SAMPLE	1	2	3	4	6	7	9	10	11	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6
POSITION IN CORE IN CM FROM TOP	0-3	3-7	7-10	10.5-13.5	15-17	17-22	27-33	33-36	36-38	43-48	48-54.5	0-4	4-7	7-10	10-13.5	13.5-15.5	15.5-19	19-22.5	22.5-26.5	26.5-29.5	29.5-32.5	32.5-35	35-36.5	36.5-38.5	38.5-41.5	1-3.5	3.5-6	6-9	9.5-14	14-18	18-21.5
TOTAL PLANKTONIC POPULATION				6		1		1	2							2	3														
PLANKTONIC SPECIES IN %																															
Globigerina bulloides				67				100																							
G. pachyderma									100																						
G. sp.						100										100	100														
Globorotalia scitula				33																											
TOTAL BENTHONIC POPULATION	148	222	366	198	11	65	28	36	47	15	22	86	86	203	181	152	390	270	246	180	387	93	49	82	117	124	98	165	248	138	96
BENTHONIC SPECIES IN %																															
Ammodiscus ssp	.7	2	2																							2					
Angulogerina angulosa											9					1	2			2		3									
Astrononion stellatum				1	18	1	14										1				.8										
Bolivina subaenariensis			.3	2																											
Bulimina aculeata				6	18	3			2																						
Cassidulina algida				10		8			13									1	1	5	4	1		5	2				.8		1
C. islandica var. minuta				1		29	43	83	38	53	36					4	7	1										.6			
C. norcrossi			.5	3		9										1			2	2	2			5							1
Cibicides lobatulus														[illegible]		5	1	1	4	3	1			2							
Eggerella advena												28	29	30	49	5	4	2	2		1	21	39	10		44	43	27	39	41	4
Elphidium articulatum														.5						1											
E. incertum var. clavatum						11		5	2		4		1	1		3	3	3	2	5	6	4		2	2					.7	2
E. subarcticum																	8	1	1	3	1	2		2	9			1	.8		
Eponides frigidus				1										1	3	20	8	11	18	10	7	10		5	12			1	5	2	4
Globobulimina auriculata				25		4			17		9		9	8	17	36	44	39	40	33	47	32	20	46	44			10	2	9	3
Haplophragmoides bradyi	28	.9	1																												
H. glomeratum	52	17	34	4					2	7		3	3	11	1		2									2	3	1		2	
Labrospira crassimargo	15	52	45	2					2			2	1	.5	1								4			8	1	11		2	
L. jeffreysi		.9	1											1		1	.8														
Lagena				2		3			2				1		1	1	8	2	1	2	1				5						
Miliolids						1																						1			
Nonion labradoricum				26	55	26	39	11	19	40	41		5	2	4	15	12	21	11	10	18	10	8	7	5			7	10	4	12
Proteonina atlantica	.7	22	9	9								1		1	2	3	3	8	7	8	2	6	12	7	10	2	2	.6			3
Recurvoides turbinatus												1		1																	
Reophax curtus	2	3	1	1								5		.5												.8	2	1	2		
R. scottii												5	2	3	3											23	16	6	5	4	
Robulus																					8										
Spirillina arctica												2																			
Spiroplectammina biformis			3	1								16	20	16	4								8			11	11	9		6	2
S. typica																												2			
Textularia torquata	.7		.5									31	28	14	10	4	1					6			9	11	11	8	12	13	6
Triloculina tricarinata							4																								
Trochammina lobata																										.8		1			
T. squamata												5		7	4		2	3	2		2	3	8	2	10	3	10	22	18	11	13
Valvulina conica		1	2	1																											
Virgulina complanata				6	9	3			2					.5																	
V. fusiformis														.5		1	5	6	7	16	3			5	7			1	8	4	10

Table 15. Distribution of Foraminifera in cores 77, 91, and 130

STATION	140									171											190												
DEPTH IN METERS	68									93											92												
SAMPLE	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11	12	13
POSITION IN CORE IN CM. FROM TOP	0-3	3-5.5	5.5-8	8-10.5	10.5-13	13-16	16-18.5	18.5-21	21-24	0-4.5	4.5-7	7-9	9-11.5	11.5-14.5	14.5-18	18-21.5	21.5-24	24-27.5	27.5-31	31-34.5	0-2.5	2.5-5.5	5.5-9	9-11	11-14	14-17	17-19	19-21.5	21.5-25	25-28	28-30.5	30.5-32.5	32.5-35
TOTAL PLANKTONIC POPULATION															2	3	8															1	
PLANKTONIC SPECIES IN %																																	
Globigerina eggeri																100																100	
G. sp.															100		100																
TOTAL BENTHONIC POPULATION	150	117	98	153	163	51	63	59	55	51	55	52	74	128	308	389	322	354	310	180	22	28	31	26	110	63	11	182	9	288	159	116	240
BENTHONIC SPECIES IN %																																	
Ammobaculites cassis					2																		3										
Ammodiscus ssp.			3																														
Angulogerina angulosa																2	.6	.6															
Astrononion stellatum												10																					
Cassidulina algida									2						9	5	6	1	6	2					.9			2		1	2	2	5
C. islandica var. minuta														8																			
C. norcrossi																												4		4	4	8	4
Cibicides lobatulus								2							.6			6															
Eggerella advena	33	16	34	30	45	53	36	46	11		2					.2			6			4	3			5				.3			
Elphidium articulatum															.9																		
E. incertum var. clavatum						2		5	4						.9	7	5	3	3	11								6		3	1	5	8
Eponides frigidus					1	6	2	2	7					4	8	15	11	10	7	10					9			2		.6	3	5	8
Globobulimina auriculata				1			19	2	15			2	13	23	32	34	33	17	32	26					42			36		21	33	29	35
Haplophragmoides glomeratum	3	3	4	5	2		2	2	4	57	36	40	28	16	8	7	11	18	16	7	50	36	48	50	20	32	18	3	44	9	2	3	2
Labrospira crassimargo	5		3		2					16	15		5	7	6	1	4	3	4	7	9	18	16	23	11	44	9	3	11	7	6	2	2
L. cf. jeffreysii											4	4	3		.6			.6															
Lagena															.6	.5		.6		6										.3			
Miliolids																.2																	
Nonion labradoricum				3	.6		5	3	11			4	22	41	36	25	30	36	30	32					17			45		46	48	41	32
Polymorphinidae																			1														
Proteonina atlantica	4	10	3	.7	5	4	5	5	9	8	9	2	9	2	1	1	.6	4	3	2	14	18	10	4	3	8	36	2	22	5	6		.8
Recurvoides turbinatus										8	16	17	9	3	2	7	3	4	1	3	5	11	10			8	9	1	11	1	6	3	
Reophax curtus		9	2						4	8	16	6	8	4	3	.5		2	1	.6	5	4	6		2	2	27	1	11	1	1	.9	
R. scottii	14	24	15	8			5	7																									
Robertina cf. charlottensis															.3																		
Spiroplectammina biformis	15	20	17	21	13	4		8		4	2	12			.3						14	4	3		9	2							
S. typica				1		2	2												.6					4									
Textularia torquata	19	14	14	22	18	6	5	7	2																								
Trochammina lobata		3		1																													
T. squamata	7	7	4	5	9	20	21	7	18			2	1								5	7			.9						1		
Virgulina complanata																	.6											.6		1	.6		
V. fusiformis				1	1	4		5	15						.6	1									.9			.6				9	2

Table 16. Distribution of Foraminifera in cores 140, 171, and 190

STATION	474						495							573						
DEPTH IN METERS	58						145							137						
SAMPLE	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
POSITION IN CORE IN CM. FROM TOP	0-3	3-7	7-10	10-13	13-15.5	15.5-18	0-2	2-5	5-8	8-12	12-13.5	13.5-15.5	15.5-19	0-2.5	2.5-5	5-7.5	7.5-10	10-13	13-17	17-20
TOTAL PLANKTONIC POPULATION			1								9	8	1							4
PLANKTONIC SPECIES IN %																				
Globigerina bulloides			100																	
G. eggeri											100									
G. sp.												100	100							100
TOTAL BENTHONIC POPULATION	175	137	166	163	8	3	78	58	73	115	115	147	281	27	59	91	62	133	340	439
BENTHONIC SPECIES IN %																				
Ammobaculites cassis	1	.7	2	1																
Ammodiscus ssp.				.6			1	3												
Angulogerina angulosa										.9			.4					.8	.3	
Astrononion stellatum													.4							
Bolivina subaenariensis												.7	2							
Bulimina aculeata										5	.9		1					2	.9	2
Cassidulina algida										.9	5	3	15					6	9	7
C. norcrossi										.9	2	3	9					1	3	3
Cibicides lobatulus													4							
Eggerella advena	49	66	66	55	12	33														
Elphidium articulatum																			.6	
E. incertum var. clavatum										3	5	3	7						1	.9
Eponides frigidus				1						6	11	8	8					10	8	7
Globobulimina auriculata				2						25	26	21	20					26	23	27
Glomospira gordialis	1																			
Haplophragmoides bradyi							3							4						
H. glomeratum	11	8	8	3		33	35	29	36					22	49	64	11			
Labrospira crassimargo	6	1	2	.6			10	10	3						29	2	34			
L. jeffreysii	.6		.6				3													
Lagena											.9	.7	.4					.8		.2
Miliolids												1								.2
Nonion labradoricum										19	34	43	28					44	47	40
N. sp.																				2
Polymorphinidae													.4							
Proteonina atlantica	10	13	9	26	75	33	35	45	47	28	13	12	6	67	20	25	44	9	7	9
Recurvoides turbinatus	3		.6				14	10	12							3	10			
Reophax arctica	1																			
R. curtus	3	1	1	1				2		3				4	2	1	2			
Robertina cf. charlottensis												2	.7							
Spiroplectammina biformis	11	4	8	4	12											3				
S. typica				3																
Textularia torquata	2	1												4		1				
Trochammina squamata	.6	4	2	1																
Virgulina complanata										.9	.9	1	2						.3	.2
V. fusiformis				2								.7								

Table 17. Distribution of Foraminifera in cores 474, 495, and 573

STATION	595						648							732										
DEPTH IN METERS	160						142							113										
SAMPLE	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11
POSITION IN CORE IN CM. FROM TOP	0-3	3-6.5	6.5-8.5	8.5-11.5	11.5-13.5	13.5-15.5	0-3	3-6	6-9	9-12	12-15	15-18	18-21	0-2.5	2.5-4.5	4.5-7.5	7.5-9.5	9.5-12	12-16	16-18	18-20	20-22	22.5-25	25-27
TOTAL PLANKTONIC POPULATION					7	3																3		
PLANKTONIC SPECIES IN %																								
Globigerina bulloides					29																			
G. eggeri					71	33																		
G. inflata																						33		
G. sp.						67																67		
TOTAL BENTHONIC POPULATION	70	54	110	82	170	105	212	143	53	8	99	433	354	112	40	66	77	266	112	5	5	160	11	2
BENTHONIC SPECIES IN %																								
Ammodiscus ssp.		2					.9	2							2									
Angulogerina angulosa												.5						.8	2			.6		50
Bolivina subaenariensis			2	1														.8						
B. sp.						.9																		
Bulimina aculeata			4	5	16	5						.5	.6											
B. marginata																		9	8			.6		
Cassidulina algida			3	15	8	14					4	8	14				1	.8	2			2		
C. islandica var. minuta																	1	7	.9		20	4		
C. norcrossi			3		1	3					1	3	4				1	38	29			19	18	
Cibicides lobatulus				1	2	.9					3	2	5											
Eggerella advena	1	4	2				6	6	4	12				2										
Elphidium articulatum				1	6	4					1	.2							10		20	3	45	
E. incertum var. clavatum					.6	2						.2	1				1	4	.9	20	60	2	9	50
E. sp.													.3						.9	20				
Eponides frigidus			.9	7	5	11					5	2	5				3	9	8			5	9	
Globobulimina auriculata			6	18	28	28					59	42	26				18	4	7	20		16		
Glomospira gordialis								.7																
Haplophragmoides bradyi	7	2					.5																	
H. glomeratum	37	15	43	2			55	39	7			.2		63	27	21	1		3			.6	9	
Labrospira crassimargo	9	6	5		.6		4	.7	13			.2		.8		14			.9	20			9	
L. jeffreysii							.5	.7									1							
Logena					1						2											.6		
Miliolids					1	.9																		
Nonion labradoricum			7	22	24	21					12	36	42				1	14	12			37		
Proteonina atlantica	33	59	18	21	3	7	9	11	47	62	5	2	.3	25	57	56	64	8	10	20		5		
Recurvoides turbinatus	10	13	2				2							2										
Reophax curtus	1		.9				.9							2	4	2	3							
R. scottii							.9	.7																
Spiroplectammina biformis							3	10						3	5				.9					
S. typica							.5				1	.2				1			.9					
Textularia torquata							6	6																
Triloculina tricarinata						.9																		
Trochammina lobata							3	.7																
T. squamata	1		2	4	2	2	7	22	28	25	7	3	.8	3	2	6	4	.8				.6		
Virgulina complanata			.9	2		.9						.2	.6					4	4			1		
V. fusiformis																						.6		

Table 18. Distribution of Foraminifera in cores 595, 648, and 732

No. 9 — *Foraminifera Species Off Portsmouth, New Hampshire*[1]

By Frances L. Parker

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INTRODUCTION

The species discussed in this paper are, for the most part, those used by Phleger in his study of the ecology of Foraminifera off Portsmouth, N. H. Some species groups that he has combined have been divided for discussion because of interesting occurrences. A few rare species are included for the same reason. The types are deposited at the U.S. National Museum in Washington, D. C.

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[1] Manuscript received for publication October 2, 1951.

N6onr-277, Task Order III. Miss Jean Peirson assisted in preparation of the material.

Locations of the samples are in Phleger's paper (see above). The area between latitudes 43°7′N and 42°41′N and longitudes 70°04′W and 70°47′W has been very extensively sampled with the exception of the southeastern portion in the vicinity of Jeffreys Ledge. This area is shown on the U. S. Coast and Geodetic chart, Portsmouth to Cape Ann, published in May, 1941 (5th edition).

PLANKTONIC FAUNA

The planktonic fauna of the Gulf of Maine is almost negligible and the species are not discussed. The specimens are mostly immature forms occurring in about 5 per cent of the samples. The species represented are: *Globigerina bulloides* d'Orbigny, *G. eggeri* Rhumbler, *G. pachyderma* (Ehrenberg), and *Globigerinoides rubra* (d'Orbigny).

BENTHONIC FAUNA

General Statement

The benthonic fauna is closely related to Arctic faunas to the north and to the faunas south of the Cape Cod barrier. Approximately 25 per cent of the species discussed are found in the Arctic, 35 per cent occur only south of Cape Cod and 30 per cent occur in both regions. The fauna is not a large one since the area is relatively small and the greatest depths are less than 200 m. For this reason it is difficult to give an adequate comparison with the southern fauna. It is well known, however, that Cape Cod forms a barrier for many of the warmer water species occurring to the south.

No samples were taken in the small bays of the area and species characteristic of such environments only are not present. An example of this is *Eponides frigidus* (Cushman) var. *calidus* Cushman and Cole which is abundant in some shallow bays of the area. A few species, however, usually associated with marsh or river faunas are found near the mouths of the rivers, such as *Trochammina macrescens* H. B. Brady and *Miliammina fusca* (H. B. Brady).

In addition to the 71 species from the Portsmouth area discussed below, two new species, *Labrospira arctica* and *Trochamminella atlantica*, have been described from the Arctic. Cushman's classification has been followed in the arrangement of the genera.

Discussion of species

Family ASTRORHIZIDAE

CRITHIONINA PISUM Goës var. HISPIDA Flint

(Plate 1, figure 1)

Crithionina pisum Goës var. *hispida* Flint, 1897 (1899), Ann. Rept., U. S. Nat. Mus., p. 267, pl. 6, fig. 2.

The Portsmouth specimens have fewer sponge spicules in the wall of the test than those figured by Flint. This is true also of specimens found by Höglund (1947, p. 36) in Swedish waters. The species is found at scattered stations in the North Atlantic. It is very rare in the Portsmouth area.

Family SACCAMMINIDAE

PROTEONINA ATLANTICA Cushman

(Plate 1, figure 2)

Proteonina atlantica Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 5, pl. 1, fig. 4.

Reophax difflugiformis H. B. Brady (part), 1884, Rept. Voy. CHALLENGER, Zool., vol. 9, p. 289, pl. 30, fig. 5 (not figs. 1–4).

Proteonina difflugiformis (part) of authors.

This species is much more coarsely arenaceous, is less flask-like in shape, and has a less pronounced neck than *P. difflugiformis* (H. B. Brady). A study of paratypes at the Cushman Laboratory showed that many of the specimens have a more prolonged neck than does the holotype. The wall of the Portsmouth specimens is very rough and is formed of angular quartz grains, sometimes up to 0.5 mm. in length, cemented with fine siliceous cement. The species is a common one south of Cape Cod and also occurs in the Arctic.

PROTEONINA DIFFLUGIFORMIS (H. B. Brady)

(Plate 1, figure 3)

Reophax difflugiformis H. B. Brady, 1879, Quart. Jour. Micr. Sci., vol. 19, p. 51, pl. 4, figs. 3a-b.; 1884 (part), Rept. Voy. CHALLENGER, Zool., vol. 9, p. 289, pl. 30, figs. 1–4 (not fig. 5).

This species differs from *P. atlantica* in its flask-like shape with a definite neck and in having a fairly fine-grained, smoothly finished wall. Occasional large grains are included in the surface of the wall but they are usually cemented flush with the surface. It is not common in the Portsmouth area. It is difficult to give the distribution of the species owing to its having been so often combined with *P. atlantica.* Apparently the latter is the more common species in northern waters of the Atlantic.

URNULINA COMPRESSA Cushman

(Plate 1, figure 4)

Urnulina compressa Cushman, 1930, Bull. 4, Florida State Geol. Surv., p. 15, pl. 1, figs. 2a, b.

Millettella spinata Cushman and McCulloch (not Cushman and Cahill), 1939, Allan Hancock Pacific Exped., vol. 6, no. 1, p. 43, pl. 2, figs. 1, 2.

Only a single specimen of this species was found. The only previously reported occurrence is from the Miocene of Florida. This specimen is identical with the holotype, with which it was compared at the Cushman Laboratory. The form figured by Cushman and McCulloch as *Millettella spinata* from the Pacific is apparently identical. The aperture of these forms appears to be more terminal than is that of the holotype as figured by Cushman and Cahill. The species is also found in rivers flowing into Long Island Sound. Since the Portsmouth specimen occurs at a station at the mouth of the Merrimack River it is probable that the form is limited to a brackish water environment.

Family HYPERAMMINIDAE

HIPPOCREPINA INDIVISA Parker

(Plate 1, figure 5)

Hippocrepina indivisa Parker, 1870, in Dawson, Canadian Nat., n. ser., vol. 5, p. 176, fig. 2.

This species is very rare. It is interesting to note that Cushman (1944, p. 6) found it to be very abundant at one station in the Gulf of Maine, off Eastport. It is recorded to the north ranging to the Arctic and from Albatross station D2018, off the coast of Maryland at 1440 m. (Cushman, 1918, p. 58).

HYPERAMMINA ELONGATA H. B. Brady

(Plate 1, figure 10)

Hyperammina elongata H. B. Brady, 1878, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 433, pl. 20, figs, 2a, b.

This species is rare in the Portsmouth area. It appears to have a widespread distribution.

Family REOPHACIDAE

HORMOSINA sp.

(Plate 1, figures 8, 9)

I have not been able to find this species in the literature, but have insufficient material to make an adequate study of it. It is very small, 0.28–0.6 mm. in length, usually composed of three to four chambers, the early chambers being globular, the last more elongate. It occurs only rarely in the Portsmouth area.

REOPHAX ARCTICA H. B. Brady

(Plate 1, figures 6, 7)

Reophax arctica H. B. Brady, 1881, Ann. Mag. Nat. Hist., ser. 5, vol. 8, p. 405, pl. 21, fig. 2.

Bigenerina arctica Cushman (part) 1948, Spec. Publ. 23, Cushman Lab. Foram. Res., p. 31, pl. 3, fig. 9 (not figs. 10, 11).

Examination of specimens by transmitted light shows that this species is uniserial throughout. Cushman's plesiotypes figured in his monograph on the Arctic were examined. The first figured specimen (fig. 9) is typical. The other two are unrelated forms. Figure 10 is a small specimen of the new species *Textularia torquata* (q. v.) and figure 11 is apparently an immature form of *Spiroplectammina biformis*.

This species occurs at many stations in the Portsmouth area. It occurs in the Arctic but is not reported from south of Cape Cod.

REOPHAX CURTUS Cushman

(Plate 1, figures 11–19)

Reophax curtus Cushman, 1920, Bull. 104, U. S. Nat. Mus., pt. 2, p. 8, pl. 2, figs. 2, 3.

Reophax scorpiurus Balkwill and Wright (not Montfort), 1885, Trans. Roy. Irish. Acad., vol. 28, Sci., p. 328, pl. 13, figs. 5a, b; Goës (part), 1894, Kongl. Svensk. Vet. Akad. Handl., vol. 25, no. 9, p. 24, pl. 5, figs. 160–167 (?not 158, 159, 168, 169).

?*Reophax subfusiformis* Earland, 1933, Discovery Repts., vol. 7, p. 74, pl. 2, figs. 16–19.

Reophax subfusiformis Höglund, 1947, Zool. Bidrag från Uppsala, bd. 26, p. 82, pl. 9, figs. 1–4; pl. 26, figs. 1–36; pl. 27, figs. 1–19; text figs. 43–50.

Reophax cf. *pilulifer* Cushman (not H. B. Brady), 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 10, pl. 1, fig. 21.

The holotype has not been seen, but from material at hand from the Gulf of Maine, where Cushman has reported the species, its characteristics can be studied. The species is a very variable one. Many specimens can be found without a neck, as described by Cushman. Many others, however, have a neck which is composed of fine material and is probably easily broken. Specimens occur with from three to five, or even six, chambers, although the majority have four. The relative size of the last chamber varies, the chambers in some specimens increasing much more gradually in size than in others. The specimens with chambers increasing most rapidly in size are usually the larger forms having very large proloculi and probably represent the megalospheric generation. It is apparently specimens of this type that Cushman used to illustrate the species.

Until Earland's specimens from the Antarctic can be seen, his species *R. subfusiformis* cannot be definitely placed in the synonymy under *R. curtus*, but it seems probable that it should be. The main difference between the two species as described and figured, aside from the presence of a neck and the number of chambers, is in the character of the wall. The holotype of *R. curtus* has a very rough, coarsely arenaceous wall. Earland's species is described as having a wall that is "thin and smoothly finished externally". In the Gulf of Maine there is a relatively small number of specimens having such a wall. One of these forms is figured (pl. 1, fig. 17). Whether or not this is a separate species or even a variety is very questionable. It is identical with the specimens of typical *R. curtus* in every other respect. Höglund's Swedish species appears to be identical with Cushman's although I have not examined specimens.

Specimens occur which are very similar to the species from Vineyard Sound referred to *R. scorpiurus?* by Cushman (1944, p. 10). The chambers increase much more slowly in size as added, but are inflated. In the ecologic study of the Portsmouth area these forms have been combined with *R. curtus* to which they appear to be closely related (pl. 1, figs. 15, 16, 18). A second form, which I am at present regarding as a variant of *R. curtus*, is very small, with uninflated chambers and a prolonged neck (pl. 1, fig. 19). It is usually associated with the typical form, but is very rare and it has been impossible to obtain enough material for study.

REOPHAX GRACILIS (Kiaer)

(Plate 2, figure 1)

Nodulina gracilis Kiaer, 1900, Rept. Norwegian Fish Mar. Invest., vol. 1, no. 7, p. 24, 2 text figs. (the left-hand one is questionable).

This species is very rare in the Portsmouth area. It is not reported elsewhere in the western Atlantic.

REOPHAX SCOTTII Chaster

(Plate 2, figure 2)

Reophax scottii Chaster, 1890–91 (1892), First Rept. Southport Soc. Nat. Sci., p. 57, pl. 1, fig. 1.

Reophax catella Höglund, 1947, Zool. Bidrag från Uppsala, bd. 26, p. 97, text figs. 77, 78.

This species is present at a number of stations in the Portsmouth area. Höglund (1947, p. 11) has wrongly interpreted the species because of having no access to Chaster's original description. He based his interpretation of the species on Cushman's (1920, p. 11) description which also appears to be in error. The original description is given here for the benefit of those who have not seen it. "Test elongate, narrow, composed of a large number (10 20) of segments which gradually increase in size; segments generally somewhat pyriform, and abruptly truncate below; aperture small; texture very delicate and transparent, the test being built up of thin scales of mica or other material neatly joined at their margins by chitinous material. The test when moist is quite flexible. Length .4–.625 mm." There is no mention of compression of the test as asserted by Cushman and later by Höglund nor of a wall composed of mica flakes "imbricately attached to a chitinous membrane" as described by Höglund. Höglund's *R. catella* seems to be identical with Chaster's form.

The species has been observed in Buzzards Bay and Long Island Sound south of Cape Cod but is not reported from the Arctic.

Family AMMODISCIDAE

AMMODISCUS CATINUS Höglund

(Plate 2, figures 3, 4)

Ammodiscus catinus Höglund, 1947, Zool. Bidrag från Uppsala, bd. 26, p. 122, pl. 8, figs. 1, 7; pl. 28, figs. 19–23; text. figs. 82–84, 105–107, 109.

This species is widespread in the Portsmouth area. Its concavo-convex character and narrow whorls distinguish it easily from the following species. It is reported only from the Swedish areas studied by Höglund.

AMMODISCUS MINUTISSIMUS Cushman and McCulloch

(Plate 2, figure 5)

Ammodiscus minutissimus Cushman and McCulloch, 1939, Allan Hancock Pacific Exped., vol. 6, p. 70, pl. 5, figs. 3, 4.

The Portsmouth specimens apparently are identical with the types examined at the Cushman Laboratory. The original description also seems to agree in all respects. This species is reported by Cushman (1944, p. 11) from shallow water, 18–33 m., in this area and at a few localities south of Cape Cod at 11 m. and 15 m.

GLOMOSPIRA GORDIALIS (Jones and Parker)

(Plate 2, figure 6)

Trochammina squamata var. *gordialis* Jones and Parker, 1860, Quart. Jour. Geol. Soc., vol. 16, p. 304; Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 408, pl. 15, fig. 32.

This species is rare.

Family LITUOLIDAE

AMMOBACULITES CASSIS (Parker)

(Plate 2, figures 8–10)

Lituola cassis Parker, 1870, in Dawson, Canadian Nat., n. ser., vol. 5, pp. 177, 180, fig. 3.

This species was named from specimens collected in Gaspé Bay, Gulf of St. Lawrence. It shows its best development in the Arctic.

Portsmouth specimens are less broad and more elongate, the chambers not extending so far down on the inner side, although steeply slanting as in normal specimens. In spite of these differences there seems no doubt that the specimens should be referred to Parker's species. It is suggested that this abnormal variation may be caused by minimum conditions for survival of the species obtaining in the Portsmouth area. It is not found farther south than Massachusetts Bay where it shows similar variations with even greater elongation of the test.

HAPLOPHRAGMOIDES BRADYI (Robertson)

(Plate 2, figure 11)

Trochammina robertsoni Brady, 1887 (not Brady, 1876), Jour. Roy. Micr. Soc., p. 893.

Trochammina bradyi Robertson, 1891, Ann. Mag. Nat. Hist., ser. 6, vol. 7, p. 388.

This species is fairly abundant in deeper parts of the Portsmouth area. It has been observed east of Cape Cod at stations deeper than 85 m. (Parker, 1948) but is not reported elsewhere in the western Atlantic, although it is found farther south in the Gulf of Mexico.

HAPLOPHRAGMOIDES GLOMERATUS (H. B. Brady)

(Plate 2, figures 13, 14)

Lituola glomerata H. B. Brady, 1878, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 433, pl. 20, figs. 1a-c.

This species is widespread in the Portsmouth area. It is not found on the continental shelf south of Cape Cod, although, like the previous species, it is found in the Gulf of Mexico. It also occurs abundantly in the Arctic.

LABROSPIRA ARCTICA n.sp.

(Plate 2, figures 7, 12)

Trochammina trullissata H. B. Brady (part) (not H. B. Brady, 1879, Quart. Jour. Micr. Sci., vol. 19 (n.s.), no. 73, p. 56, pl. 5, figs. 10a, b, 11), 1884, Rept. Voy. CHALLENGER, Zool., vol. 9, p. 342, pl. 40, figs. 14a, b (not figs. 13a, b, 15, 16).

Test small, compressed, partially evolute; periphery rounded, slightly lobulate; chambers 6–7 in the adult whorl, slightly inflated;

sutures straight, slightly depressed; wall very smooth, polished, finely arenaceous; aperture small, narrow, slightly curved, with a broad protuberant lip. Maximum diameter 0.4 mm., maximum thickness 0.11 mm.

Holotype from station 12, Baffin Bay at a depth of 629 m.; Lat. 74°46′N., Long. 74°25′W.

This species differs from other described species such as *L. jeffreysii* in the smooth, highly polished wall. It also differs from *L. jeffreysii* in the more regular, less lobulate periphery, straighter sutures, and smaller size. It has the same type of wall as *Haplophragmoides bradyi* and this feature makes it very distinctive. It has been observed only in samples from Baffin Bay, from water depths greater than 250 m. It is of interest to note that figures 10a, b of *Trochammina trullissata* Brady 1879 are identical with the CHALLENGER Report figures, pl. 40, figs. 13a, b, which Cushman (1910, p. 113, text figs. 174a, b) renamed *Cyclammina bradyi*. This form should, therefore, retain the specific name *trullissata*. Brady's figure 11 of 1879 is a section which was not reproduced in the CHALLENGER Report and apparently represents a *Haplophragmoides*. Whether or not this figure represents the same species as his figures 10a, b is somewhat questionable and the genus may be referable to *Cyclammina* as stated by Cushman.

LABROSPIRA CRASSIMARGO (Norman)

(Plate 2, figures 16a, b)

Haplophragmium crassimargo Norman, 1892, Mus. Normanianum, pt. 8, p. 17.

Haplophragmium canariense Brady (part) (not d'Orbigny), 1884, Rept. Voy. CHALLENGER, Zool., vol. 9, p. 310, pl. 35, fig. 4 (not figs. 1–3, 5).

Haplophragmoides major Cushman, 1920, Bull. 104, U. S. Nat. Mus., pt. 2, p. 39, pl. 8, fig. 6.

Labrospira crassimargo Höglund, 1947, Zool. Bidrag från Uppsala, bd. 26, p. 141, pl. 11, fig. 1; text figs. 121–125.

Study of a paratype specimen of *Haplophragmoides major* at the Cushman Laboratory shows it to have the "intereo-areal" aperture designated by Höglund (1947, p. 141) as the distinguishing characteristic of the genus *Labrospira*. Since, as Höglund points out (1947, p. 143), Cushman's characterization of the aperture of *H. major* as "an elongate semicircular slit at the base of the final chamber, the upper portion forming a thin lip" is the only apparent basis for a separation of this form from Norman's, the two species would seem to be synonymous. I have compared the paratype specimens with Arctic specimens from Greenland as well as with the Portsmouth forms and all appear to be identical. As Höglund points out, the detection of the presence of the lower lip is sometimes difficult.

There is a possibility that d'Orbigny incorrectly analyzed the character of the aperture of *Haplophragmoides canariensis* (*Nonionina canariensis* d'Orbigny, 1839, in Barker-Webb and Berthelot, Hist. Nat. Iles Canaries, vol. 2, pt. 2, "Foraminifères," p. 128, pl. 2, figs. 33, 34) which was designated by Cushman as the genotype of *Haplophragmoides* (1910, p. 99). A study of material from the Canary Islands or of type material (if possible) should clarify this point and is necessary to determine the final validity of Höglund's genus.

This species is very common in the Portsmouth area. It is found at shallow depths (15 m.–90 m.) but occurs only rarely in the area farther south (Parker, 1948, p. 222). It is common in the Arctic.

LABROSPIRA JEFFREYSII (Williamson)

(Plate 2, figures 15, 17–20)

Nonionina jeffreysii Williamson, 1858, Rec. Foram. Great Britain, p. 34, pl. 3, figs. 72, 73.

Haplophragmoides columbiensis Cushman 1944, (not Cushman, 1925), Spec. Publ. 12, Cushman Lab. Foram. Res., p. 11, pl. 2, fig. 1; Parker, 1948, Bull. Mus. Comp. Zoöl., vol. 100, no. 2, p. 238, pl. 4, fig. 17.

The Portsmouth specimens are somewhat larger than those described by Williamson, with a diameter up to 0.83 mm., and have 6–7 chambers in the adult whorl rather than 7–8 as described by him. In other respects the two species appear to be identical. *H. columbiensis* (Cushman) has a more smoothly polished surface and more flexuose sutures. There is considerable variation in the amount of involution.

This species is widespread in the Portsmouth area, usually occurring at low frequencies. It is found east of Cape Cod but is not reported farther south. Similar specimens occur in the Arctic.

LABROSPIRA cf. NITIDA (Goës)

(Plate 2, figures 21, 22)

Haplophragmium nitidum Goës, 1896, Bull. Mus. Comp. Zoöl., vol. 29, p. 30, pl. 3, figs. 8, 9.

The tests of the Portsmouth specimens do not appear to be as finely arenaceous or as polished as those of Goës's Caribbean form. They are more smoothly finished and have a more polished surface, however, than such forms as *L. crassimargo*. The species is very rare in this area and has not hitherto been reported in the western Atlantic north of South Carolina.

RECURVOIDES TURBINATUS (H. B. Brady)

(Plate 2, figures 23, 24)

Haplophragmium turbinatum H. B. Brady, 1881, Quart. Jour. Micr. Sci., n. s., vol. 21, p. 50; 1884, Rept. Voy. CHALLENGER, Zool., vol. 9, p. 312, pl. 35, figs. 9a-c.

This species seems to fit Brady's description and figures very well, the only apparent discrepancy being in size. The Portsmouth specimens attain a maximum diameter of 0.4 mm. Brady describes specimens up to 0.75 mm. Brady describes the species as having six chambers in the final whorl which is true also of the Portsmouth specimens. Cushman (1920, pp. 81, 82) says that it may have up to eight chambers. It seems probable that he has confused Brady's form with another, possibly *R. contortus* Earland, or that he has included more than one species under this name. Höglund's species *R. trochamminiformis* (1947, p. 149) also shows some resemblance to this species but apparently has somewhat more inflated chambers. It is possible, though, that it should be placed in the synonymy under this species.

The species is a very common one in the Portsmouth area and has also been observed at stations in the vicinity of Greenland. It is reported by Parker (1948, p. 238) from the continental shelf east of Cape Cod.

Family TEXTULARIIDAE

SPIROPLECTAMMINA BIFORMIS (Parker and Jones)

(Plate 3, figures 1, 2)

Textularia agglutinans d'Orbigny var. *biformis* Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 370, pl. 15, figs. 23, 24.

Spiroplectammina sp. Parker, 1948, Bull. Mus. Comp. Zoöl., vol. 100, no. 2, p. 239, pl. 4, fig. 21.

This species is common at many stations. There is a good deal of size variation in the specimens from different stations. Microspheric specimens vary from 0.07–0.14 mm. in width and 0.25–0.54 mm. in length; megalospheric individuals from 0.11–0.14 mm. in width and 0.21–0.36 mm. in length. I have seen specimens from off Greenland with a maximum length of 0.65 mm. and maximum width of 0.21 mm. This species is recorded by Cushman (1944, p. 13) from just south of Cape Cod.

SPIROPLECTAMMINA TYPICA Lacroix

(Plate 3, figures 3–8)

Spiroplectammina typica Lacroix, 1931, Bull. Instit. Ocean., Monaco, no. 582, p. 14, fig. 9; 1932, ibid, no. 591, p. 6, text figs. 2, 3.

The specimens from the Portsmouth area are larger than those figured by Lacroix. His specimens, figured in 1932, are approximately 0.22 mm. and 0.13 mm. in length and 0.08 mm. and 0.06 mm. in width. The Portsmouth specimens have a maximum length of 0.65 mm. and maximum width of 0.25 mm. In other respects the forms seem to be identical. This size discrepancy is a large one but it does not give a sufficient basis for the erection of a new species. *S. typica* is a much more compressed form than *S. biformis*. It has been reported previously only from the Mediterranean.

TEXTULARIA TORQUATA n.sp.

(Plate 3, figures 9–11)

Bigenerina arctica Cushman (part) (not H. B. Brady), 1948, Spec. Publ. 23, Cushman Lab. Foram. Res., p. 31, pl. 3, fig. 10 (not figs. 9, 11).

Test small, compressed and frequently somewhat twisted, rapidly tapering from the broadest part near the apertural end; periphery slightly lobulate due to the overlapping of the chambers; chambers 5–6 pairs in the biserial portion, slightly inflated; sutures slightly depressed, slanting downward at an angle of about 45°; wall rough, coarsely arenaceous; aperture narrow, loop-shaped, extending up into the apertural face almost to the apex of the test. Maximum length 0.29 mm., maximum width 0.15 mm., maximum thickness 0.07 mm.

Holotype from station 114 at a depth of 93 m., Lat. 42°45.7′N, Long. 70°29.3′W.

This species most closely resembles *T. contorta* Höglund but differs in having clearly visible, somewhat depressed sutures; in the aperture which is an elongate loop instead of horseshoe-shaped; and in the fact that many individuals show a definite coil at the initial end.

This species is widespread in the Portsmouth area and is found off Greenland where it has been observed in samples from Baffin Bay and the Kane Basin.

Family VALVULINIDAE

EGGERELLA ADVENA (Cushman)

(Plate 3, figures 12, 13)

Verneuilina advena Cushman, 1921 (1922), Contr. Canadian Biol., no. 9, p. 141.
Verneuilina polystropha Cushman (not Reuss), 1920, Rept. Canadian Arctic Exped., vol. 9, pt. M, p. 8, pl. 1, fig. 5.
Eggerella arctica Höglund, 1947, Zoöl. Bidrag från Uppsala, bd. 26, p. 193, pl. 16, fig. 4; text figs. 166–168.

This species was first referred to *Verneuilina polystropha* Cushman, 1920, as pointed out by Cushman (1948, p. 32). The fact that he also included a reference to *V. polystropha* Heron-Allen and Earland, 1913, in a later paragraph does not alter the fact that the Arctic specimens should form the basis for the conception of the species. The specimen figured by Cushman in 1920 is 0.42 mm. long. Oddly enough the drawing shows a hint of multiple chambers in the initial portion of the test although Cushman described it originally as triserial throughout. The species is common in the Portsmouth area. It occurs on the continental shelf south of Cape Cod at depths of less than 90 m. (Parker, 1948, p. 221) and is also found in the Arctic.

VALVULINA CONICA Parker and Jones

(Plate 3, figures 14, 18)

Valvulina triangularis d'Orbigny var. *conica* Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 406, pl. 15, fig. 27.
Valvulina triangularis Parker and Jones (not d'Orbigny), 1857, Ann. Mag. Nat. Hist., ser. 2, vol. 19, p. 23 (295), pl. 11, figs. 15, 16.

This species is found in small percentages at many stations. South of Cape Cod it is found in the deepest facies, 300–680+m., in small numbers (Parker, 1948, p. 226). It occurs as far north as the Gulf of St. Lawrence (Cushman, 1922, p. 62).

Family SILICINIDAE

MILIAMMINA FUSCA (H. B. Brady)

(Plate 3, figures 15, 16)

Quinqueloculina fusca H. B. Brady, 1870, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 47 (286), pl. 11, figs. 2a-c, 3.

Quinqueloculina fusca H. B. Brady var. *groenlandica* Cushman 1944 (not Cushman, 1933), Spec. Publ. 12, Cushman Lab. Foram. Res., p. 14, pl. 2, fig. 21.

This species is somewhat more coarsely arenaceous than the other reported species of the genus. In other respects it is typical. There is some variation in size, but the maximum observed length is 0.5 mm. It is found only at nearshore stations in the Portsmouth area. It is reported in England from brackish water near the mouths of rivers and by Phleger and Walton (1950, p. 280) from Barnstable Harbor. The species has also been observed south of Cape Cod in Long Island Sound in brackish and nearshore water. The form from the Arctic figured under this name by Cushman (1948, p. 33, pl. 3, figs. 16, 17) does not belong to this species.

In connection with the study of *M. fusca* at the Cushman Laboratory, specimens of "*Quinqueloculina groenlandica*" Cushman were examined and found to belong to the genus *Miliammina*.

Family MILIOLIDAE

PYRGO SUBSPHAERICA (d'Orbigny)

(Plate 3, figure 17)

Biloculina subsphaerica d'Orbigny, 1839, Hist. Phys. Pol. Nat. Cuba, "Foraminifères," p. 162, pl. 8, figs. 25–27.

This species is rare. It has not been previously reported from north of Cape Cod. It is rare in the facies from 90–300 m. south of Cape Cod (Parker, 1948, p. 224).

QUINQUELOCULINA ARCTICA Cushman

(Plate 3, figures 19a, b)

Quinqueloculina arctica Cushman, 1933, Smithsonian Misc. Coll., vol. 89, no. 9, p. 2, pl. 1, figs. 3a-c.

Typical specimens occur in the Portsmouth area. A few reach a length of 1.0 mm. although Cushman gives the maximum length of Arctic specimens as 0.65 mm. (Cushman, 1948, p. 35). The species is not common but is of interest as being the first noted occurrence south of the Arctic. A few specimens have been observed south of Cape Cod near Block Island.

QUINQUELOCULINA FRIGIDA n.sp.

(Plate 3, figures 20a, b)

Test medium in size, periphery rounded but not broad; chambers protruding on the four-chambered side but with rounded angles, the center chamber on the three-chambered side narrow, in a concave area formed by the outer chambers; wall somewhat rough, the outer layer formed of medium-sized sand grains set in a ferruginous calcareous cement; aperture rounded on a slightly projecting neck, with a simple tooth. Maximum length 0.8 mm.; maximum width 0.6 mm.; maximum thickness 0.4 mm.

Holotype from station 610 at a depth of 37 m.; Lat. 43°04.6′N, Long. 77°33.6′W.

This species somewhat resembles *Q. agglutinata* Cushman, which was described from off Alaska. It is smaller and the chambers are less sharply angled and much narrower at the outer periphery making the test less thick in proportion to the width. Cushman described *Q. agglutinata* (1917, p. 43) as 0.9 mm. in length but specimens have been observed from Dundas Harbor, near Greenland, more than 1.0 mm. in length. *Q. frigida* occurs at several stations in the Portsmouth area but is not abundant.

QUINQUELOCULINA SEMINULA (Linné)

(Plate 3, figures 21a, b, 22a, b; pl. 4, figures 1, 2)

Serpula seminulum (Linné), 1758, Syst. Nat., ed. 10, p. 786.

This species is rare. It is apparently more common at Cushman's shallow water stations in the Gulf of Maine (Cushman, 1944, p. 13). On the continental shelf south of Cape Cod it is found in the facies from 15–90 m. (Parker, 1948, p. 221). It is also reported from the Arctic.

QUINQUELOCULINA SUBROTUNDA (Montagu)

(Plate 4, figures 4a, b)

"Serpula subrotunda dorso elevato" Walker and Boys, 1784, Test. Min., p. 2. pl. 1, fig. 4.

Vermiculum subrotundum Montagu, 1803, Test. Brit., pt. 2, p. 521.

Vermiculum disciforme Macgillivray, 1843, Hist. Moll. Anim. Aberdeen, p. 319.

Miliolina seminulum (Linné) var. *disciformis* Williamson, 1858, Rec. Foram. Great Britain, p. 86, pl. 7, figs. 188, 189.

Occasional specimens are seen with *Massilina*-like chambers as pointed out by Cushman (1948, p. 35). This characteristic and the character of the aperture make the inclusion of the species in the genus *Quinqueloculina* somewhat questionable. It is reported from the Arctic and also occurs south of Cape Cod. It is rare in the Portsmouth area. Many forms referred to "*Quinqueloculina secans* d'Orbigny" and "*Triloculina circularis* Bornemann" in the literature may be referable to *Q. subrotunda*.

TRILOCULINA TRICARINATA d'Orbigny

(Plate 4, figure 5)

Triloculina tricarinata d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 299, no. 7; Modèles no. 94.

The Portsmouth specimens are slightly more rounded at the periphery than d'Orbigny's model. The species is rare. It is difficult to get accurate information on its distribution elsewhere in the western Atlantic although Parker (1948, p. 227) reports it as rare south of Cape Cod in her deepest facies at 300-680 m. It is also reported from the Arctic but the reliability of these reports is doubtful.

Family TROCHAMMINIDAE

TROCHAMMINA ADVENA Cushman

(Plate 4, figures 3a, b)

Trochammina advena Cushman, 1922, Carnegie Instit. Washington, Publ., p. 20, pl. 1, figs. 2–4.

?*Trochammina* cf. *rotaliformis* Höglund, 1947 (not Wright, 1911), Zoöl. Bidrag från Uppsala, bd. 26, p. 198, pl. 17, figs. 1, 2; text figs, 180, 181.

This species is found in small numbers at many stations. It is identical with Cushman's species except for a slightly greater inflation of the chambers. It is reported from the Tortugas region off Florida, from the Gulf of Mexico and as *T. globulosa* Cushman, by Parker (1948, p. 240) from the continental shelf east of Cape Cod.

TROCHAMMINA INFLATA (Montagu)

(Plate 4, figures 6, 10).

Nautilus inflatus Montagu, 1808, Test. Brit., Suppl., p. 81, pl. 18, fig. 3.

The specimens from the Portsmouth area are small but otherwise typical. They are found only at nearshore stations. The species is found south of Cape Cod but is not reported from the Arctic.

TROCHAMMINA LOBATA Cushman

(Plate 4, figures 7a, b)

Trochammina lobata Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 18, pl. 2, fig. 10.

This species was described from the Gulf of Maine. It also occurs south of Cape Cod at depths shallower than 90 m. (Parker, 1948, p. 221).

TROCHAMMINA MACRESCENS H. B. Brady

(Plate 4, figures 8a, b)

Trochammina inflata (Montagu) var. *macrescens* H. B. Brady, 1870, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 51, pl. 11, figs. 5a-c.

This species is rare at two shallow stations. It also occurs in brackish water in Long Island Sound. The species reported by Phleger and Walton (1950, p. 280) from Barnstable Harbor, north of Cape Cod, should be referred to *Jadammina polystoma* Bartenstein and Brand. The two forms appear to be distinct and have not been found together at the same locality.

TROCHAMMINA QUADRILOBA Höglund

(Plate 4, figures 9a, b)

Trochammina quadriloba Höglund, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 2, p. 46.

Trochammina pusilla Höglund, 1947 (not Geinitz, 1848), Zoöl. Bidrag från Uppsala, bd. 26, p. 201, pl. 17, figs. 4a-c; text figs. 183, 184.

This species appears to be identical with Höglund's. It is rare at many stations. The species has also been observed in material from Lancaster Sound, off Greenland. It has not been previously reported except by Höglund in his Swedish material.

TROCHAMMINA SQUAMATA Parker and Jones and related species

(Plate 4, figures 11–16)

Trochammina squamata Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 407, pl. 15, figs. 30, 31a-c.

T. squamata and its allied species are treated as a unit in analyzing the faunal distribution. This is done because of the difficulty of differentiating the forms in counting without causing great delay. Since they usually appear to act as a faunal unit it does not seem worthwhile to attempt a separation. Some of the species of this group, which are represented, are: the typical species (pl. 4, figs. 11, 12) which seems to be identical with "*T. propria* Cushman" (1944, p. 19, pl. 2, fig. 11); *T. ochracea* (Williamson) (*Rotalina ochracea* Williamson, 1858, p. 55, pl. 4, fig. 112; pl. 5, fig. 113) (pl. 4, figs. 13, 14); and *T.* (*Remaneica*) *helgolandica* Rhumbler (1938, p. 195, figs. 38–45) (pl. 4, figs. 15, 16).

Representatives of this group are found in the Arctic and in shallow water samples south of Cape Cod. They are widespread in the Portsmouth area.

TROCHAMMINELLA ATLANTICA n.sp.

(Plate 4, figures 17a, b, 18, 19)

Test small, slightly compressed, with a low trochoid spire; periphery rounded, very lobulate; chambers 5–6 in the adult whorl, more commonly 5, inflated, especially toward the outer part; sutures distinct, depressed, slightly curved; wall thin, slightly rough, composed of medium sand grains of varying size; aperture an elongate slit near the inner margin of the chamber, with a distinct lip. Maximum diameter 0.47 mm., maximum thickness 0.22 mm.

Holotype from Core 16, Melville Sound, off Canada, at 124 m., Lat. 74°34′N, Long. 110°40′W.

This species is often found associated with *T. bullata* Höglund but may be distinguished easily by its somewhat larger size, lower spire and more numerous, less globose chambers. Some specimens appear distorted owing to the uneven inflation of the chambers. Except for the character of the aperture the species shows a rather close resemblance to *Trochammina advena* Cushman.

Family LAGENIDAE

OOLINA COSTATA (Williamson)

(Plate 4, figures 20, 21)

Entosolenia costata Williamson, 1858, Rec. Foram. Great Britain, p. 9, pl. 1, fig. 18.

Lagena costata Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 21, pl. 3, fig. 4.

O. costata is not reported elsewhere in the western Atlantic. A few specimens have been observed in material from off Greenland.

Family POLYMORPHINIDAE

PSEUDOPOLYMORPHINA NOVANGLIAE (Cushman)

(Plate 5, figure 1)

Polymorphina lactea (Walker and Jacob) var. *novangliae* Cushman, 1923, Bull. 104, U. S. Nat. Mus., pt. 4, p. 146, pl. 39, figs. 6–8.

This species was described from the Gulf of Maine. It is found south of Cape Cod and is reported from Gaspé Bay.

Family NONIONIDAE

ASTRONONION STELLATUM Cushman and Edwards

(Plate 5, figures 2, 3)

Nonionina elegans d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 294, no. 10 (nomen nudum).
Fornasini, 1899 (not Williamson, 1858), Mem. Accad. Sci. Bologna, ser. 5a, vol. 7, p. 655, fig. 5.

Nonionina stelligera d'Orbigny (part) of authors.

Astrononion stellatum Cushman and Edwards, 1937, Contr. Cushman Lab. Foram. Res., vol. 13, pt. 1, p. 32, pl. 3, figs. 9–11.

Astrononion stelligerum Cushman, 1948 (not d'Orbigny, 1839), Spec. Publ. 23, Cushman Lab. Foram. Res., p. 55, pl. 6, fig. 6.

d'Orbigny's species was based on specimens collected from "le banc de 'Terre-Neuve' "; since there is no accompanying designation it is a *nomen nudum*. Fornasini's figure, one of d'Orbigny's unpublished figures, shows the species to be identical with *Astrononion stellatum* Cushman and Edwards described from off southern Iceland. The latter name stands owing to the appearance of Williamson's "*Nonionina*" *elegans* before Fornasini's publication of the figure of d'Orbigny's species. The species bears a close resemblance to the Mediterranean form *Astrononion stelligerum* (d'Orbigny) but is more compressed and has a more lobulate periphery caused by the greater inflation of the chambers. It commonly has 7–8 chambers although occasional specimens have more.

The species has not been found south of Cape Cod in the western Atlantic.

ELPHIDIUM ADVENUM (Cushman) var. MARGARITACEUM Cushman

(Plate 5, figure 4)

Polystomella advenum Cushman var. *margaritaceum* Cushman, 1930, Bull. 104, U. S. Nat. Mus., pt. 7, p. 25, pl. 10, fig. 3.

This species is very rare in the Portsmouth area. On the continental shelf south of Cape Cod it is reported in shallow water samples by Cushman (1944, p. 26).

ELPHIDIUM ARTICULATUM (d'Orbigny)

(Plate 5, figures 5–7)

Polystomella articulata d'Orbigny, 1839, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères," p. 30, pl. 3, figs. 9, 10.

Nonion orbiculare Cushman (not H. B. Brady), 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 24, pl. 3, fig. 24.

A comparison with specimens from the Falkland Islands, one of the localities from which d'Orbigny described the species, shows the Portsmouth species to be almost identical although slightly less compressed. Specimens are found with opaque and translucent tests, the latter being the forms which Cushman called *N. orbiculare* in this area. His plesiotype of this form was studied and found to be different from the plesiotype of *N. orbiculare* from the Arctic (Cushman, 1948, pl. 6, fig. 3). The retral processes, though present in the translucent forms, are much less prominent. This feature may be observed in other species of *Elphidium*, notably *E. incertum*, where a superficial examination of a large group of specimens has suggested that several species are present depending on the degree of translucence of the test. *E. articulatum* has the supplementary apertures on the apertural face characteristic of *Cribroelphidium* Cushman and Bronnimann. They appear in varying degree in many species of *Elphidium* and if a division of the genus on this basis is necessary, as seems improbable, it should more appropriately appear as a subgeneric one.

E. articulatum appears to be closely related to *E. bartletti* Cushman. The adult forms of the latter species have a maximum of 12 chambers instead of the 10 or less of the former. The young specimens of *E. bartletti*, however, appear to be identical with *E. articulatum*. It is possible that *E. bartletti* represents the Arctic development of *E. articulatum*, which is not reported from that area.

ELPHIDIUM EXCAVATUM (Terquem)

(Plate 5, figure 8)

Polystomella excavata Terquem, 1875, Essai Class. Anim. Dunkerque, pt. 1, p. 25, pl. 2, figs. 2a-f.

The few specimens found are very similar to specimens at the Cushman Laboratory from Bognor, England. The species is reported from shallow waters north of Cape Cod by Cushman (1944, p. 26). It also occurs south of Cape Cod in the Long Island Sound-Buzzards Bay area.

ELPHIDIUM INCERTUM (Williamson) var. CLAVATUM Cushman

(Plate 5, figures 10, 11)

Elphidium incertum (Williamson) var. *clavatum* Cushman, 1930, Bull. 104, U. S. Nat. Mus., pt. 7, p. 20, pl. 7, figs. 10a, b.

This variety is the commonest form of Williamson's species found in the Portsmouth area. It is variable, however, and some specimens may not belong to the variety. Most of the specimens have a ventral plug or plugs of varying size which do not appear in Williamson's figure or description. South of Cape Cod in the shallow water of Long Island Sound and nearby bays the species is even more variable. *E. incertum* and variants are reported in the western Atlantic from the coast of Maryland to the Arctic.

ELPHIDIUM SUBARCTICUM Cushman

(Plate 5, figure 9)

Elphidium subarcticum Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 27, pl. 3, figs. 34, 35.
Nonion pauciloculum Cushman, *ibid.*, p. 24, pl. 3, fig. 25.

This species is very common. It shows the same variable characteristics of the other species of this genus. The sutures, though typically not depressed, sometimes appear as sharp, deep incisions where the amorphous material usually filling in the area is absent. The retral processes are frequently concealed by this amorphous material and it is specimens of this type which Cushman calls by the name *Nonion pauciloculum.* A study of large suites of specimens, however, shows that this species cannot be isolated. Retral processes could be observed in autotypes kindly furnished by Cushman.

Stunted specimens with four or five chambers have been observed from nearshore stations in Long Island Sound and Massachusetts Bay, apparently living at the minimum conditions for survival. This form is widespread on the continental shelf south of Cape Cod and is also found in the Arctic.

NONION LABRADORICUM (Dawson)

(Plate 5, figure 12)

Nonionina labradorica Dawson, 1860, Canadian Nat., vol. 5, p. 191, fig. 4.

This species occurs in its typical form. Its range extends northward to the Arctic but it is not found south of Cape Cod.

NONIONELLA AURICULA Heron-Allen and Earland

(Plate 5, figures 13a, b, 14a, b)

Nonionella auricula Heron-Allen and Earland, 1930, Jour. Roy. Micr. Soc., vol. 50, p. 192, pl. 5, figs. 68-70.

The Portsmouth specimens are about twice as large as those described by Heron-Allen and Earland, with a maximum length of 0.5 mm. The species is rare. Cushman (1944, p. 25) reports it from a few stations just south of Cape Cod, although *N. atlantica* seems to be better represented in that area. Similar, though considerably larger, specimens have been observed in the Arctic.

NONIONELLA TURGIDA (Williamson) var. DIGITATA Nørvang

(Plate 5, figures 15, 16)

Nonionella turgida (Williamson) var. *digitata* Nørvang, 1945, Zoöl. Iceland, vol. 2, pt. 2, Foraminifera, p. 29, text. fig. 4.

This variety is very rare. The only previous report is by Nørvang from off Iceland in 141 m.

Family BULIMINIDAE

ANGULOGERINA ANGULOSA (Williamson)

(Plate 5, figures 18, 19)

Uvigerina angulosa Williamson, 1858, Rec. Foram. Great Britain, p. 67, pl. 5, fig. 140.

Most of the specimens are smaller and less sharply angled than those seen from the vicinity of Ireland. At some stations, however, larger, more typical specimens are found. South of Cape Cod it is not found shallower than 63 m. (Parker, 1948). Cushman (1944, p. 30) reports it from shallow areas in the Gulf of Maine from 18 m. to 33 m., but it is found only rarely in the Portsmouth area.

BOLIVINA PSEUDOPLICATA Heron-Allen and Earland

(Plate 5, figure 17)

Bolivina pseudoplicata Heron-Allen and Earland, 1930, Jour. Roy. Micr. Soc., vol. 50, p. 81, pl. 3, figs. 36–40.

This species is rare in the Portsmouth area. It is apparently found only in shallow water of less than 90 m. as reported by Cushman (1944, p. 29) and Parker (1948, p. 221). The same is true of most of the reported occurrences around the British Isles although in the vicinity of Sweden Höglund reports its greatest frequency at 200 m. in the Skagerak (Höglund, 1947, p. 263).

BOLIVINA PSEUDOPUNCTATA Höglund

(Plate 5, figures 20, 21)

Bolivina pseudopunctata Höglund, 1947, Zoöl. Bidrag från Uppsala, bd. 26, p. 273, pl. 24, fig. 5; pl. 32, figs. 23, 24; text figs. 280, 281, 287.

This species is rare. It does not exceed the 0.4 mm. length described by Höglund as typical. Larger specimens have been seen from the vicinity of Greenland, where the species is found in greater abundance. It has not been observed elsewhere in the western Atlantic.

BOLIVINA SUBAENARIENSIS Cushman

(Plate 5, figure 22)

Bolivina subaenariensis Cushman, 1922, Bull. 104, U. S. Nat. Mus., pt. 3, p. 46, pl. 7, fig. 6.

The species is rare in the Portsmouth area, being more common in the deeper water of the area. South of Cape Cod it does not occur in the percentage counts shallower than 114 m. (Parker, 1948, p. 225).

BULIMINA ACULEATA d'Orbigny

(Plate 5, figures 23–25)

Bulimina aculeata d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 269, no. 7; — Fornasini, 1901, Mem. Accad. Sci. Bologna, ser. 5, vol. 9, p. 373, text. fig. 4.

Polymorpha pineiformia Soldani (part), 1791, Testacea, vol. 1, pt. 2, p. 118, pl. 127, fig. 1?; pl. 130, fig. *vv*.

Bulimina pupoides d'Orbigny var. *spinulosa* Williamson, 1858, Rec. Foram. Great Britain, p. 62, pl. 5, fig. 128.

This species varies considerably in the amount of ornamentation. Some forms are almost smooth while others have well-developed spines at the initial portion of the test and occasional spines at the margins of the chambers which sometimes overhang slightly. There is no sharp undercutting at the margins of the chambers as in *B. marginata* d'Orbigny. South of Cape Cod *B. marginata* reaches its peak of frequency at shallower depths than *B. aculeata*. There seems to be no evidence in these localities for the combining of the two species advocated by Höglund (1947, p. 227). *B. aculeata* in the Portsmouth area has a maximum length of 0.54 mm. (excluding the basal spines).

BULIMINA MARGINATA d'Orbigny

(Plate 5, figure 26)

Bulimina marginata d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 269, no. 4, pl. 12, figs. 10–12.

Bulimina pulchella d'Orbigny, 1839, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères," p. 50, pl. 1, figs. 6, 7.

Bulimina serrata Bailey, 1851, Smithsonian Contr., vol. 2, p. 12, pl., figs. 32–34.

This species shows great variation in its character in different parts of the world but is fairly uniform in the Portsmouth area. It is smaller and slightly more spinose than the typical Rimini specimens, never attaining a length greater than 0.5 mm. Similar forms are found along the continental shelf to the south but are distinct from the *B. marginata* var. of Parker (1948, p. 225) found at the outer edge of the shelf. These forms are much more spinose and are distinct from the more typical *B. marginata* which usually attains its greatest frequency at around 100 m. It is possible that a relationship between the deep-water variety and a very spinose form of *B. aculeata*, with which it is frequently associated, might be traced.

BULIMINELLA ELEGANTISSIMA (d'Orbigny)

(Plate 5, figures 27, 28)

Bulimina elegantissima d'Orbigny, 1839, Voy. Amér. Mérid., vol. 5, pt. 5, "Foraminifères," p. 51, pl. 7, figs. 13, 14.

This species is rare in the Portsmouth area. I have observed it in Long Island Sound and Buzzards Bay south of Cape Cod and it is reported from Vineyard Sound by Cushman (1944, p. 27).

GLOBOBULIMINA (DESINOBULIMINA) AURICULATA (Bailey)

(Plate 5, figure 29)

Bulimina auriculata Bailey, 1851, Smithsonian Contr., vol. 2, p. 12, pl., figs. 25–27.

Bulimina pyrula Flint (not d'Orbigny), 1899, U. S. Nat. Mus. Rept., 1897, p. 290, pl. 36, figs. 4, 5.

Höglund (1947, p. 252) places this species in the genus *Globobulimina.* The subgeneric name is retained for this species, which is the subgenotype. Höglund suggests that future revision of this genus may reveal that the subgeneric restriction is unnecessary. If, as he suggests (Höglund, 1947, p. 242), forms like *Bulimina pyrula* d'Orbigny are to be included in the genus, it seems reasonable that forms of the type of Bailey's species should be given subgeneric distinction.

This species is abundant in the Portsmouth area. It occurs also south of Cape Cod at depths greater than 90 m. (Parker, 1948, p. 225). It is replaced in the Arctic by the variety *arctica* named by Höglund (1947, p. 254).

"ROBERTINA" cf. CHARLOTTENSIS (Cushman)

(Plate 5, figures 30a, b)

Cassidulina charlottensis Cushman, 1925, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, p. 41, pl. 6, figs. 6, 7.

The species is too rare in this area to identify it with certainty. It appears to resemble closely Höglund's "*Robertina arctica*" d'Orbigny (Höglund, 1947, p. 219). I cannot agree with his interpretation of d'Orbigny's species. An examination of d'Orbigny's figure shows that the aperture extends into the face of the last-formed chamber well above the suture marking the chamber division while in Höglund's species the aperture extends into the chamber from the point of the chamber division. In Höglund's genus *Robertinoides*, on the other hand, the upper part of the main aperture is well up in the upper half of the chamber while the smaller one is at the boundary of the two chamber parts, the so-called "lip" coming in between. This is apparently the case in d'Orbigny's figure although he draws the suture of the division of the chamber and does not indicate the presence of any apertural opening at that point. The specimens assigned to *Robertina arctica* by Cushman and Parker (1947, p. 74) appear to be identical with d'Orbigny's figured form except that there is a narrow apertural opening along the inner part of the chamber division. I believe that it would have been easy for d'Orbigny to overlook this, merely believing it to be a part of the dividing suture. Höglund's detailed study of the two genera is an interesting one and reveals the morphological differences between them. If my interpretation of d'Orbigny's figure is correct Höglund's genus *Robertinoides* should be placed in the synonymy under *Robertina* and a new genus erected for the single-apertured form.

I have observed a single specimen of *R.* cf. *charlottensis* in material from Greenland.

VIRGULINA COMPLANATA Egger

(Plate 6, figures 1a, b, 2a, b)

Virgulina schreibersiana Czjzek var. *complanata* Egger, 1893, Abhandl. k. bayer. Akad. Wiss. München, Cl. 2, bd. 18, p. 292, pl. 8, figs. 91, 92.

Virgulina sp., Parker, 1948, Bull. Mus. Comp. Zoöl., vol. 100, no. 2, p. 240, pl. 5, fig. 14.

The Portsmouth specimens are smaller than those from the Pacific, the longest being about 0.5 mm. They are also somewhat less attenuated than the Pacific specimens. Specimens sent to the Cushman Laboratory by Earland from Drake Strait in the Antarctic are very similar. The species also resembles *V. concava* Höglund, which is perhaps synonymous with Egger's species. The form figured by Cushman from Nigare, Greece (Cushman, 1937, pl. 4, fig. 17 (not figs. 14, 15)), which was examined at the Cushman Laboratory, does not belong to this species.

The species occurs on the continental shelf south of Cape Cod and somewhat more compact specimens have been observed from off Greenland.

VIRGULINA FUSIFORMIS (Williamson)

(Plate 6, figures 3–6)

Bulimina pupoides d'Orbigny var. *fusiformis* Williamson, 1858, Rec. Foram. Great Britain, p. 63, pl. 5, figs. 129, 130.

This species is common in the Portsmouth area. It is found south of Cape Cod and also occurs in material from off Greenland.

Family ROTALIIDAE

DISCORBIS COLUMBIENSIS Cushman

(Plate 6, figures 7a, b, 8a, b, 9a, b)

Discorbis columbiensis Cushman, 1925, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, p. 43, pl. 6, figs. 13a-c; Cushman and Todd, 1947, Spec. Publ. 21, Cushman Lab. Foram. Res., p. 20, pl. 3, figs. 14–16.

Discorbis bertheloti (d'Orbigny) var. *floridensis* Cushman, 1944 (not Cushman, 1931), Spec. Publ. 12, Cushman Lab. Foram. Res., p. 31, pl. 4, fig. 17.

Discorbis obtusa Cushman (not *Rosalina obtusa* d'Orbigny), 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 31, pl. 4, fig. 15.

Discorbis subaraucana Cushman 1944 (not Cushman, 1922), Spec. Publ. 12, Cushman Lab. Foram. Res., p. 31, pl. 4, fig. 18.

The Portsmouth specimens appear to be identical with the holotype from Queen Charlotte Sound, British Columbia. They occur only at nearshore stations. In this area they show comparatively little variation or abnormality of growth. Specimens from Long Island Sound, however, vary greatly and show abnormalities similar to those described by Cushman and Todd from Friday Harbor (1947, p. 20, pl. 3, figs. 14–16). These forms may be identical with *Discorbis valvulata* (d'Orbigny). The forms so referred by Cushman from the shallow water of the Atlantic coast (1944, p. 31) are not identical, but specimens from Porto Rico so labeled by him are very close to my specimens. D'Orbigny's species was described from Martinique. This question must be left open until further study of West Indian specimens can be made. Adult forms from the Portsmouth area have five chambers in the last-formed whorl, young specimens about six.

DISCORBIS SQUAMATA n.sp.

(Plate 6, figures 10a, b, 11)

Test small, flat, slightly convex on the dorsal side, concave on the ventral, usually with a small ventral plug, composed of 2 to 2½ whorls; periphery subacute, non-lobulate; chambers 5 to 6 in the adult whorl, slightly curved, increasing gradually in size as added, on the ventral side often with lip-like processes extending into the umbilical area; sutures narrow, flush with the surface, slightly curved on the dorsal side, on the ventral side depressed, flexuose; wall thin, often translucent, finely perforate on both sides; aperture normal. Maximum diameter 0.14–0.25 mm.; minimum diameter 0.11–0.21 mm.

Holotype from station 356 at a depth of 29 m., N. Lat. 42°49.8′, W. Long. 70°45.0′.

This species occurs at a few stations shallower than 50 m. It is smaller and more compressed than *D. subaraucana* Cushman, has fewer chambers to the whorl and a more finely perforate test. Unlike *D. columbiensis* in the same general area, it shows little variation. Somewhat larger specimens closely resembling this species but having seven to eight chambers have been observed from Block Island Sound south of Cape Cod. It is probable that the conception of the species should be expanded to include these forms.

EPONIDES FRIGIDUS (Cushman)

(Plate 6, figures 12a, b)

Pulvinulina karsteni H. B. Brady (not Reuss), 1864, Trans. Linn. Soc. London, vol. 24, p. 470, pl. 48, fig. 15; 1878, Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 436, pl. 21, fig. 11.

Pulvinulina repanda (Fichtel and Moll), var. *karsteni* Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 396, pl. 14, figs. 14, 15, 17.

Pulvinulina frigida Cushman, 1921 (1922), Contr. Canadian Biol., p. 144.

The Portsmouth specimens are much smaller than those of the Arctic region. They reach a maximum diameter of 0.32 mm. Although Cushman states the maximum diameter to be 0.4 mm., specimens up to 0.6 mm. have been observed from the Arctic. Otherwise, the species in the Portsmouth area appears to be typical. It is interesting that all the specimens obtained by Cushman (1944, p. 34) from the shallow waters of this area belong to the variety *calidus*. I examined these specimens at the Cushman Laboratory and found them to be very typical and quite different from the deeper-water form with its acute periphery.

This species is reported as *E. frigidus* var. *calidus* by Parker (1948, p. 238) from all facies south of Cape Cod.

EPONIDES UMBONATUS (Reuss)

(Plate 6, figures 13a, b)

Rotalina umbonata Reuss, 1851, Zeitschr. deutsch. geol. Ges., vol. 3, p. 75, pl. 5, figs. 35a-c.

Truncatulina tenera H. B. Brady, 1884, Rept. Voy. CHALLENGER, Zoöl., vol. 9, p. 665, pl. 95, figs. 11a-c.

This species is rare. It is not reported from the Arctic but is found south of Cape Cod at stations deeper than 90 m. (Parker, 1948, p. 225).

EPONIDES WRIGHTII (H. B. Brady)

(Plate 6, figures 14, 15)

Discorbina parisiensis J. Wright (part) (not d'Orbigny), 1876–77 (1877), Proc. Belfast Nat. Field Club., App. p. 105, pl. 4, figs. 2a-c.

Discorbina wrightii H. B. Brady, 1881, Ann. Mag. Nat. Hist., ser. 5, vol. 8, p. 413, pl. 21, figs. 6a-c.

This species is very rare in this area. It is more abundant in shallow water samples of the Long Island Sound area.

PATELLINA CORRUGATA Williamson

(Plate 6, figures 16, 17)

Patellina corrugata Williamson, 1858, Rec. Foram. Great Britain, p. 46, pl. 3, figs. 86–89.

This species is rare. It occurs in the Arctic and in the Long Island Sound - Buzzards Bay area.

PNINAELLA (?) PULCHELLA n.sp.

(Plate 6, figures 18a, b, 19, 20)

Test small, compressed, very slightly convex on the dorsal side, slightly concave on the ventral side, with secondary plates forming over the apertures extending ½–⅔ of the way to the periphery forming a star-shaped central portion; periphery narrow, rounded; chambers 7–9 in the last-formed whorl, narrow, increasing very gradually in size as added, uninflated, the secondary plates somewhat inflated, each one successively covering the aperture of the previous chamber; sutures on the dorsal side flush with the surface, slightly curved, slightly limbate, on the ventral side somewhat depressed; wall thin, finely perforate, often translucent; aperture loop-shaped, variable in size, extending up into the chamber on the ventral side, occasionally absent when a secondary chamber has formed after the last-formed chamber. Maximum diameter 0.22 mm.; maximum thickness 0.07 mm.

Holotype from station 356 at a depth of 29 m., Lat. 42°49.8′N., Long. 70°45.0′W.

This species is questionably placed in the genus *Pninaella* because of its close resemblance to *Pninaella nitidula* (Chaster) which was placed in this genus by Brotzen (1948, p. 120). There can be no question of the generic similarity of the two species. I have had considerable difficulty, however, in discovering from Brotzen's description the relationship between *P. nitidula* and his generic description and genotype *P. scanica* Brotzen. He makes no mention of the secondary plates formed over the apertures, which would seem to be an important generic character. They are apparently not present in the genotype. Specimens of *P. nitidula*, however, sent by Heron-Allen to Cushman show the secondary plates. The problem cannot be solved until Brotzen's types of *P. scanica* can be studied and compared with those of the Recent species.

P. (?) *pulchella* differs from *P. nitidula* in having a rounded, non-keeled periphery, in the secondary plates which do not extend to the periphery, and in having a maximum of 9 instead of 8 chambers in the last-formed whorl. Although our specimens of *P.* (?) *pulchella* are larger than the described specimens of *P. nitidula*, larger specimens of that species have been observed from the Mediterranean. Some of the Mediterranean specimens have 2½ whorls.

P. (?) *pulchella* is found only at a few stations at less than 50 m. It also occurs near Fishers Island, at the entrance to Long Island Sound. In both places it is associated with *Discorbis squamata* n.sp.; although the two species show some similarities there seems to be no doubt of their independent identities.

Family CASSIDULINIDAE

CASSIDULINA ALGIDA Cushman

(Plate 6, figures 21a, b)

Cassidulina algida Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 35, pl. 4, fig. 24.

This species is easily identified by its inflated chambers. This feature is not emphasized by Cushman but study of the types and the abundant specimens from the Portsmouth area shows it to be one of the most outstanding characteristics. I have also observed the species in material from Baffin Bay, Greenland. It is not reported elsewhere.

CASSIDULINA ISLANDICA Nφrvang var. MINUTA Nφrvang

(Plate 6, figures 22a, b, 23)

Cassidulina islandica Nørvang var. *minuta* Nørvang, 1945, Zoöl. Iceland, vol. 2, pt. 2, Foraminifera, p. 43, text figs. 8a-c.

This variety apparently is identical with Nφrvang's. It has the triangular tooth described by him. Although the chambers are somewhat inflated, the inflation is much less than in *C. algida*. The specimens correspond in size with Nφrvang's figured specimens (0.24–0.26 mm. in length). Somewhat larger specimens have been observed from Dundas Harbor and North Devon Harbor, off Greenland (up to 0.32 mm. in length).

CASSIDULINA NORCROSSI Cushman

(Plate 6, figures 24, 25)

Cassidulina norcrossi Cushman, 1933, Smithsonian Misc. Coll., vol. 89, no. 9, p. 7, pl. 2, figs. 7a-c.

This species is reported from the Arctic and the Gulf of Maine by Cushman (1944, p. 35). South of Cape Cod it occurs in zones 3 and 4, 90 m. to 680 m., but reaches its peak of frequency beyond 300 m. (Parker, 1948, p. 225). It is not common in the Portsmouth area.

Family ANOMALINIDAE

CIBICIDES LOBATULUS (Walker and Jacob)

Nautilus lobatulus Walker and Jacob, 1798, Adams Essays, Kannmacher's ed., p. 642, pl. 14, fig. 36.

This species is very abundant in this area. It is found at all latitudes in the north Atlantic.

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Contribution No. 589, Woods Hole Oceanographic Institution
Contribution No. 7, Marine Foraminifera Laboratory.

PLATE 1

Fig. 1. *Crithionina pisum* Goës var. *hispida* Flint. X 48. Sta. 507.
Fig. 2. *Proteonina atlantica* Cushman. X 48. Sta. 668.
Fig. 3. *Proteonina difflugiformis* (H. B. Brady). X 38. Sta. 8.
Fig. 4. *Urnulina compressa* Cushman. X 70. Sta. 404.
Fig. 5. *Hippocrepina indivisa* (Parker). X 48. Sta. 163.
Figs. 6, 7. *Reophax arctica* H. B. Brady. X 70. (6) Sta. 649; (7) Sta. 82.
Figs. 8, 9. *Hormosina* sp. X 70. Sta. 21.
Fig. 10. *Hyperammina elongata* H. B. Brady. X 48. Sta. 21.

Figs. 11–19. *Reophax curtus* Cushman and variants. (11–18) X 48. (11, 12) Sta. 668; (13) Sta. 384; (14, 15) Sta. 667; (16) Sta. 521; (17) Sta. 53; (18) Sta. 482; (19) X 38. Sta. 14.

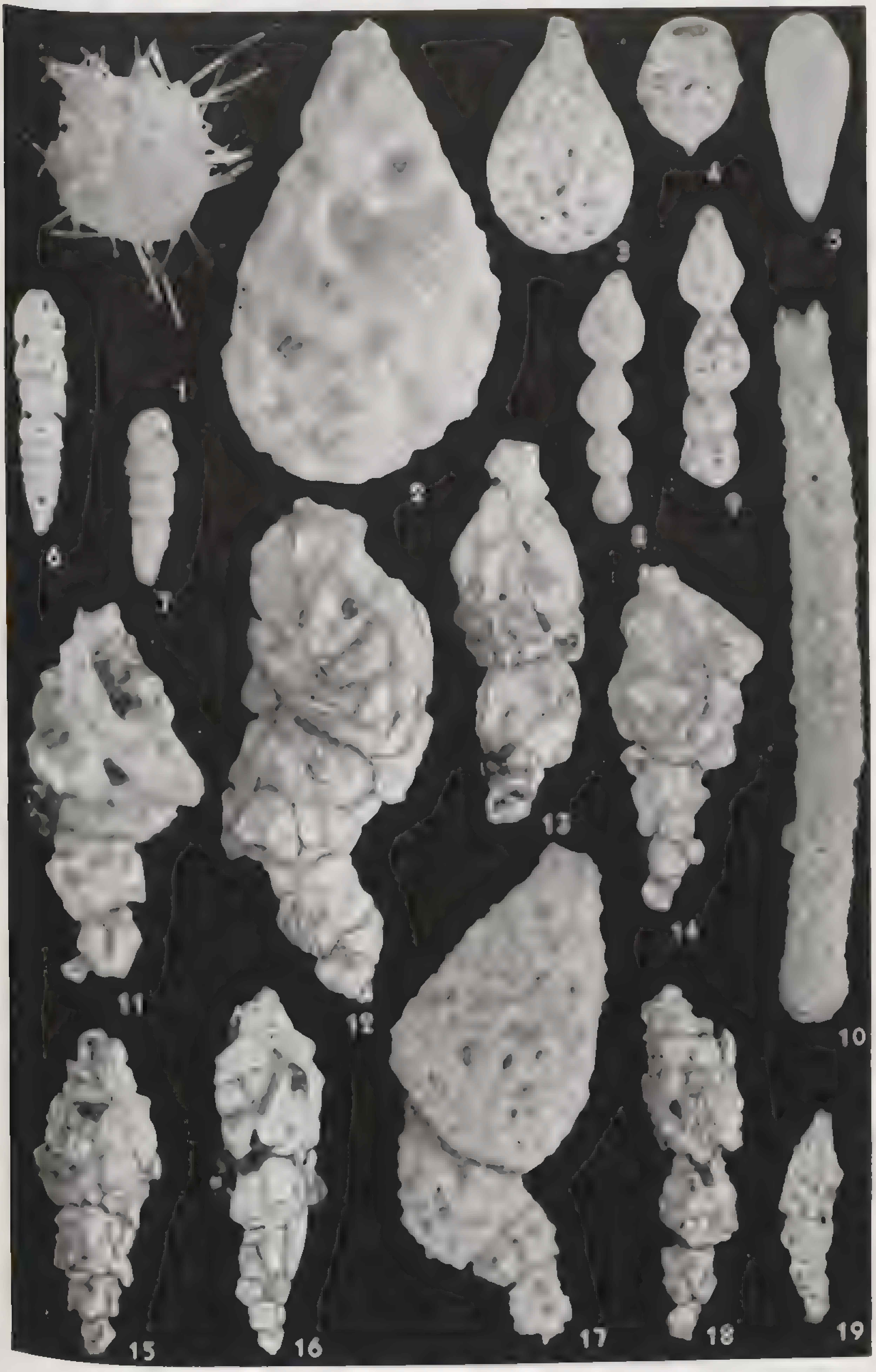
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PLATE 2

Fig. 1. *Reophax gracilis* Kiaer. X 70. Sta. 74.

Fig. 2. *Reophax scottii* Chaster. X 70. Core 130, no. 1.

Figs. 3, 4. *Ammodiscus catinus* Höglund. (3) X 70; (4) X 47. Sta. 275.

Fig. 5. *Ammodiscus minutissimus* Cushman. X 48. Sta. 275.

Fig. 6. *Glomospira gordialis* (Jones and Parker). X 48. Sta. 668.

Figs. 7, 12. *Labrospira arctica* n.sp. X 70. (7) Paratype; (12) Holotype. Baffin Bay, Sta. 12.

Figs. 8, 9, 10. *Ammobaculites cassis* (Parker). (8) X 48. Core 47, no. 1; (9, 10) X 34. (9) Sta. 144; (10) Sta. 618.

Fig. 11. *Haplophragmoides bradyi* (Robertson). X 70. Sta. 275.

Figs. 13, 14. *Haplophragmoides glomeratus* (H. B. Brady). X 48. (13) Sta. 668; (14) Sta. 647.

Figs. 15, 17, 18, 19, 20. *Labrospira jeffreysii* (Williamson). X 48. (15, 18) Sta. 275; (17) Sta. 40; (19) Sta. 647; (20) Sta. 27.

Figs. 16a, b. *Labrospira crassimargo* (Norman). X 48. Sta. 668.

Figs. 21, 22. *Labrospira* cf. *nitida* (Goës). X 48. Sta. 21.

Figs. 23, 24. *Recurvoides turbinatus* (H. B. Brady). X 48. Sta. 668.

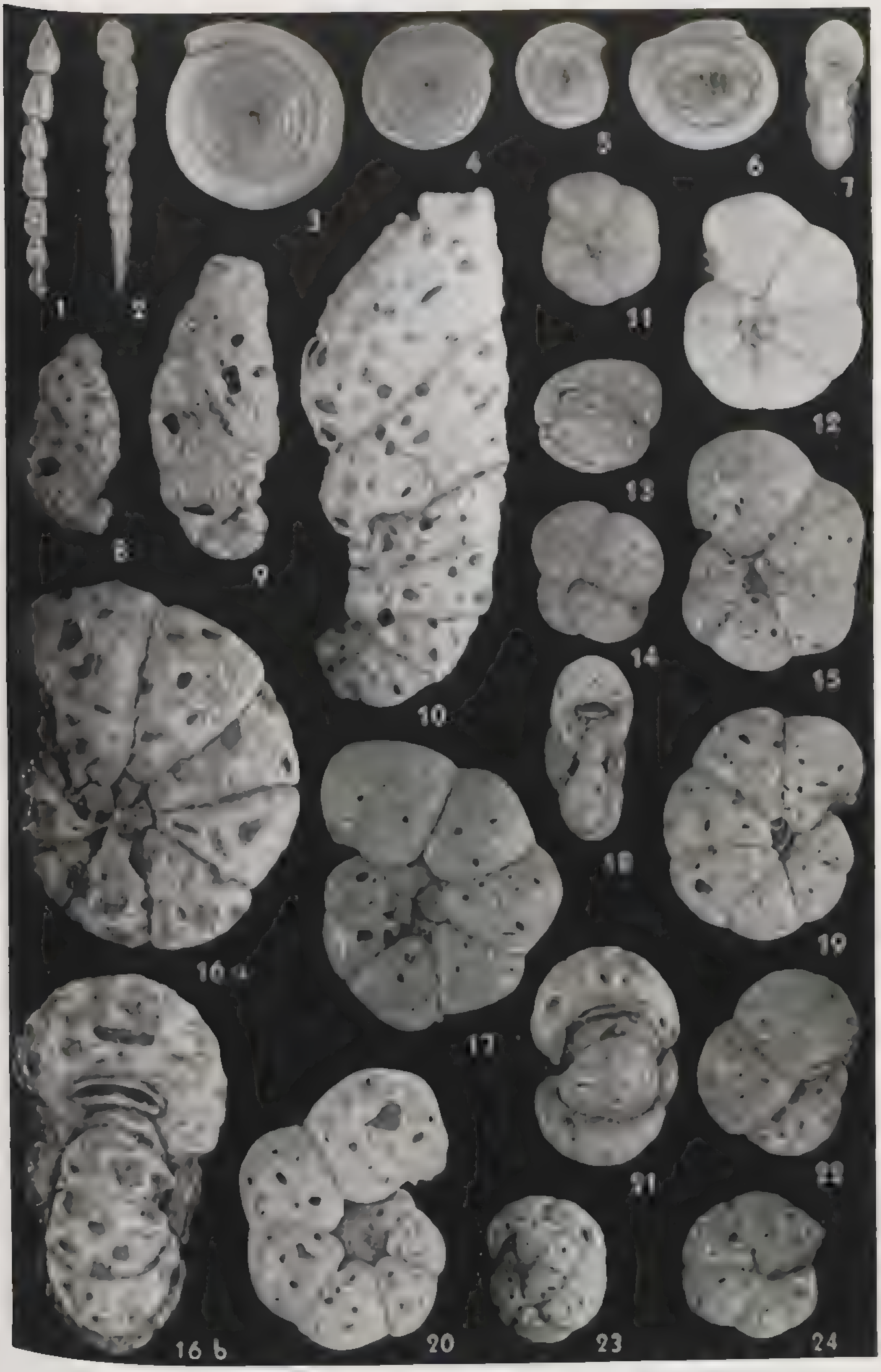
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PLATE 3

Figs. 1, 2. *Spiroplectammina biformis* (Parker and Jones). X 70. Sta. 48.

Figs. 3, 4, 5, 6, 7, 8. *Spiroplectammina typica* Lacroix. (3, 4, 5, 7) X 48; (6, 8) X 70. (3, 6) Sta. 706; (4) Sta. 642; (5) Sta. 685; (7, 8) Sta. 625.

Figs. 9, 10, 11. *Textularia torquata* n.sp. X70. (9) Holotype; (11) Paratype. Sta. 114; (10) Sta. 35.

Figs. 12, 13. *Eggerella advena* (Cushman). (12) X 70. Sta. 668; (13) X 48. Sta. 317.

Figs. 14, 18. *Valvulina conica* Parker and Jones. (14) X 48. (18) X 38. Sta. 718.

Figs. 15, 16. *Miliammina fusca* (H. B. Brady). (15) X 48. (16) X 70. Sta. 404.

Fig. 17. *Pyrgo subsphaerica* (d'Orbigny). X 48. Sta. 57 (bottom).

Figs. 19a, b. *Quinqueloculina arctica* Cushman. X 36. Sta. 610.

Figs. 20a, b. *Quinqueloculina frigida* n.sp. X 48. Holotype. Sta. 610.

Figs. 21a, b, 22a, b. *Quinqueloculina seminula* (Linné). X 48. (21) Sta. 356. (22) Sta. 439.

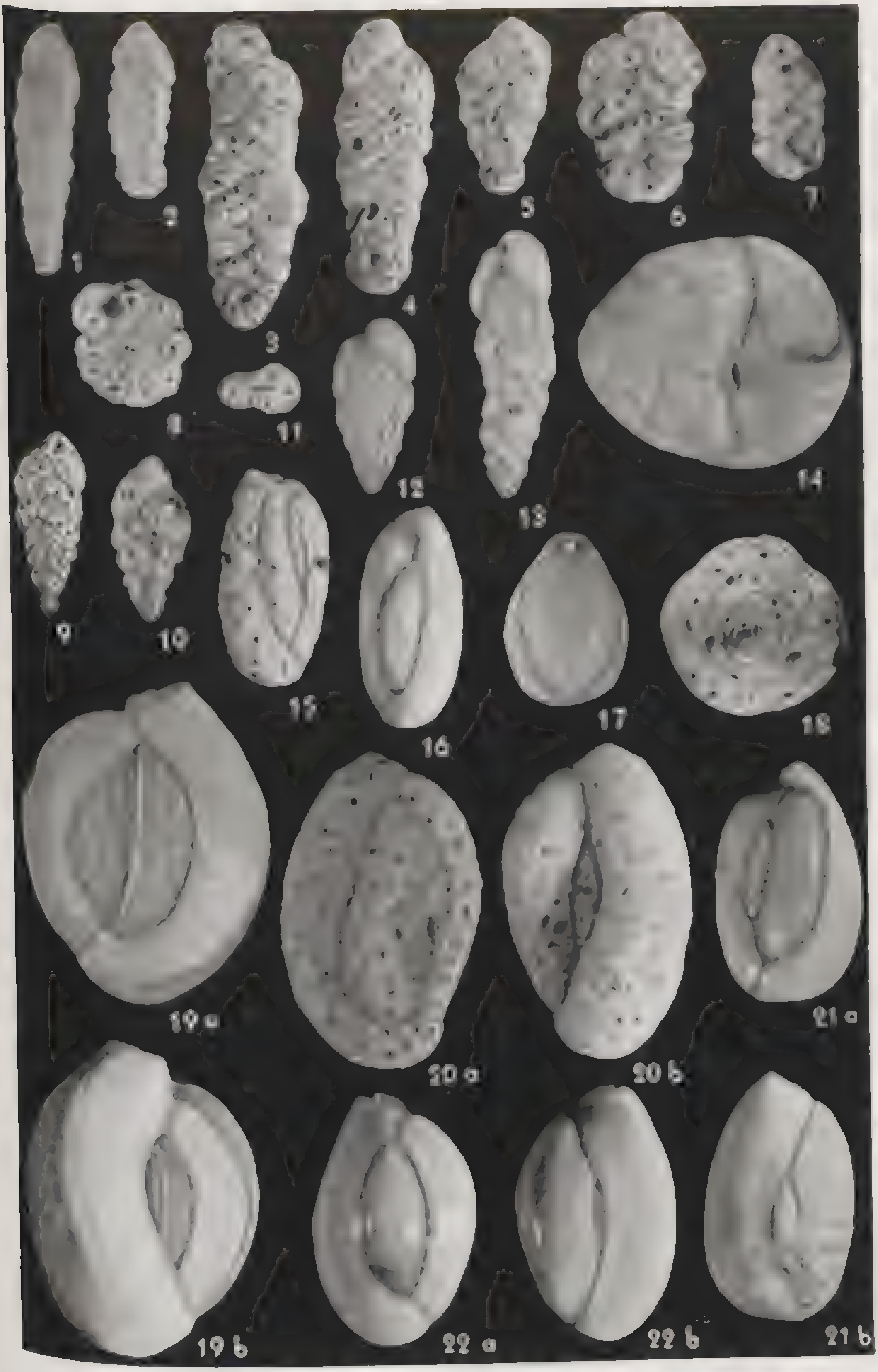
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PLATE 4

Figs. 1, 2. *Quinqueloculina seminula* (Linné). X 36. (1) Sta. 439; (2) Sta. 395.

Figs. 3a, b. *Trochammina advena* Cushman. X 48. Sta. 526.

Figs. 4a, b. *Quinqueloculina subrotunda* (Montagu). X 48. Sta. 610.

Fig. 5. *Triloculina tricarinata* d'Orbigny. X 48. Sta. 708.

Figs. 6, 10. *Trochammina inflata* (Montagu). (6) X 70. (10) X 48. Sta. 404.

Figs. 7a, b. *Trochammina lobata* Cushman. X 48. Sta. 338.

Figs. 8a, b. *Trochammina macrescens* H. B. Brady. X 48. Sta. 404.

Figs. 9a, b. *Trochammina quadriloba* Höglund. X 70. Sta. 85.

Figs. 11, 12. *Trochammina squamata* Parker and Jones. X 70. Sta. 610.

Figs. 13, 14. *Trochammina ochracea* (Williamson). X 70. Sta. 610.

Figs. 15, 16. *Trochammina* (*Remaneica*) *helgolandica* Rhumbler. X 70. Sta. 610.

Figs. 17, 18, 19. *Trochamminella atlantica* n.sp. X 70. (17) Holotype; (18, 19) Paratypes. Core 16, Melville Sound.

Figs. 20, 21. *Oolina costata* (Williamson). X 48. Sta. 708.

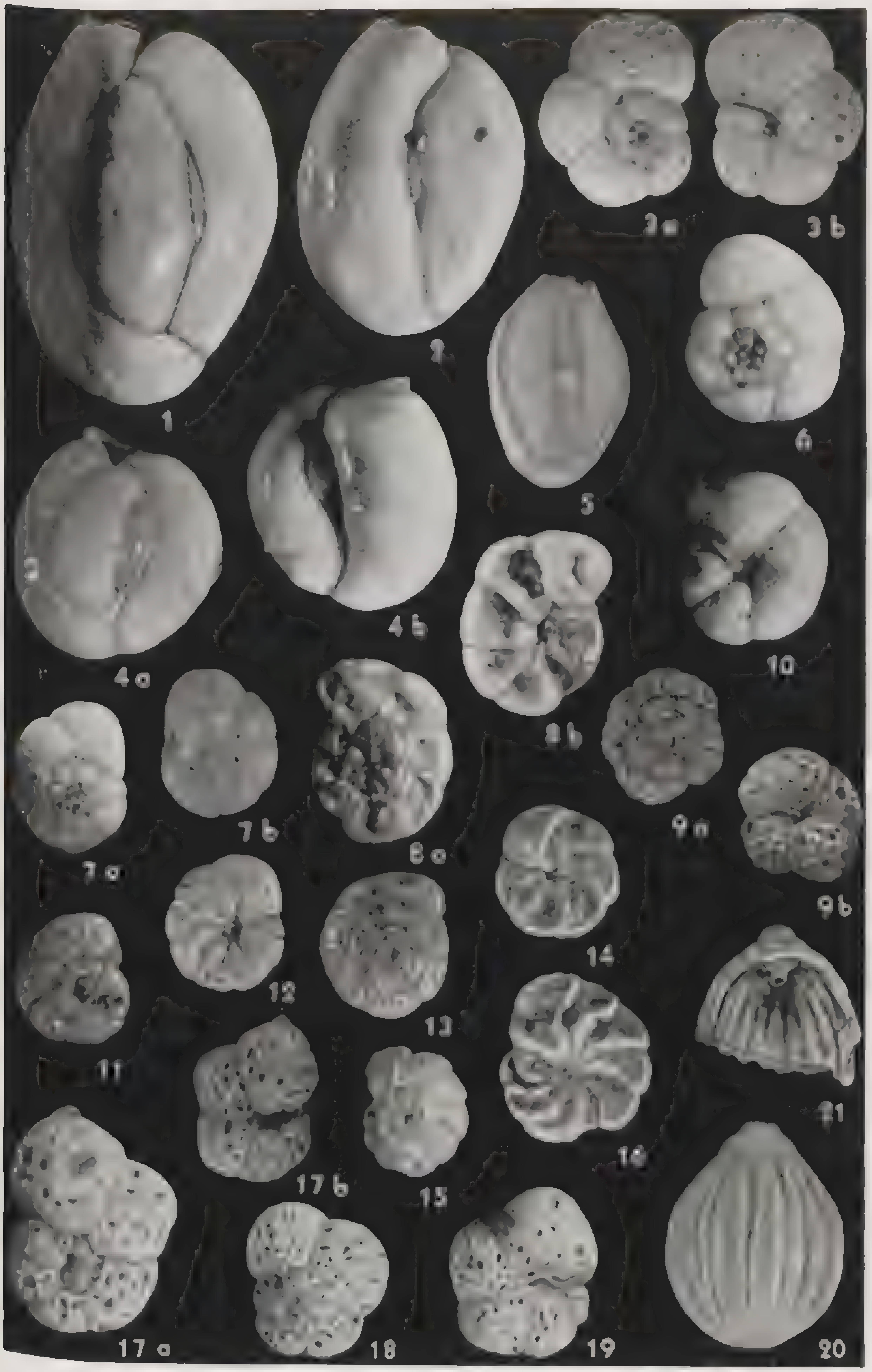
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PLATE 5

Fig. 1. *Pseudopolymorphina novangliae* (Cushman). X 36. Sta. 708.

Figs. 2, 3. *Astrononion stellatum* Cushman and Edwards. X 70. Sta. 556.

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Figs. 5, 6, 7. *Elphidium articulatum* d'Orbigny. (5) X 36. Sta. 556; (9, 7) X 48. Sta. 610.

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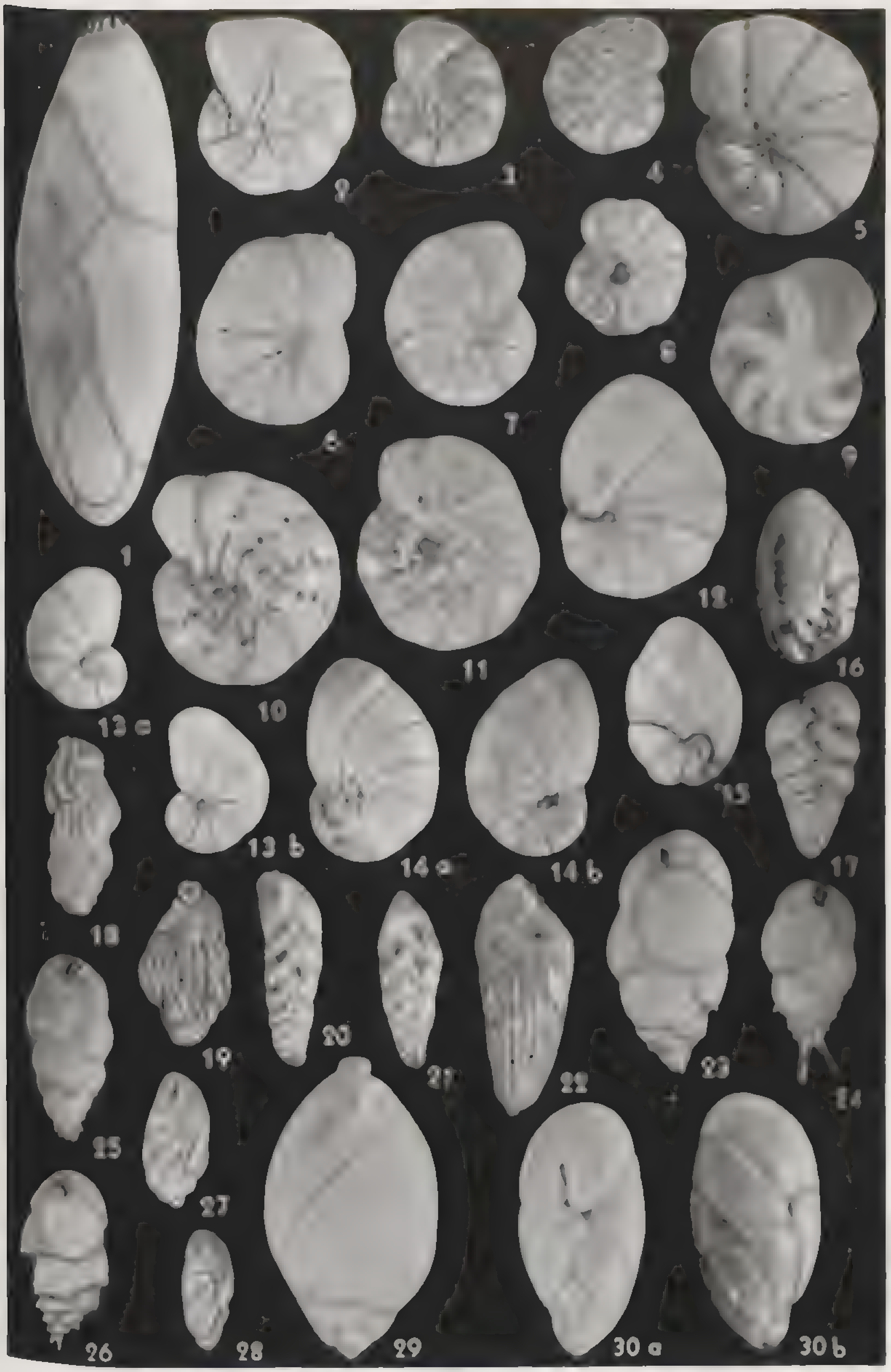
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Figs. 13a, b. *Eponides umbonatus* (Reuss). X 48. Core 2, no. 12.

Figs. 14, 15. *Eponides wrightii* (H. B. Brady). X 38. Sta. 678.

Figs. 16, 17. *Patellina corrugata* Williamson. X 70. Sta. 610.

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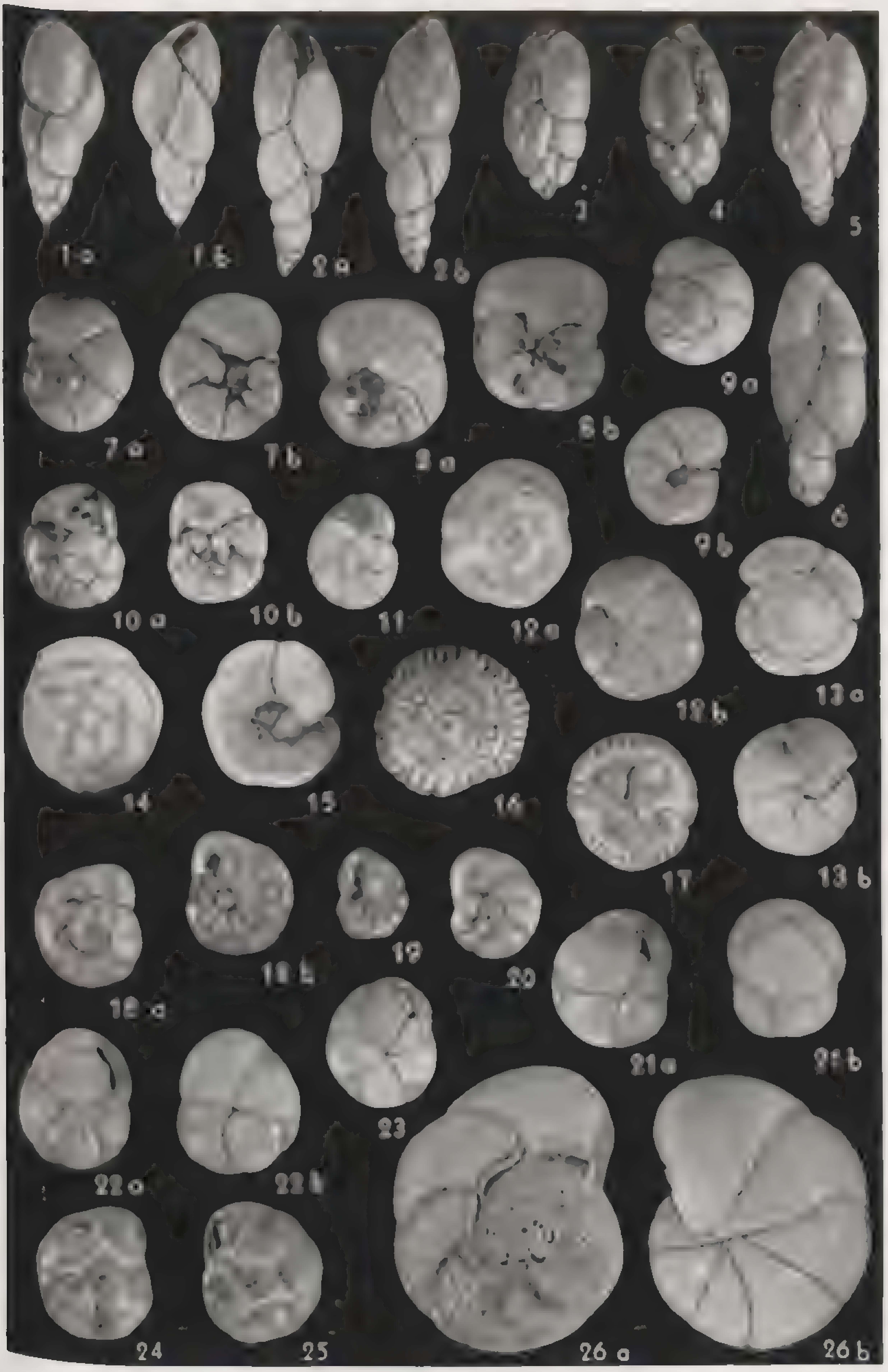
Figs. 26a, b. *Cibicides lobatulus* (Walker and Jacob). X 48. Sta. 610.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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. 106, No. 10

FORAMINIFERAL DISTRIBUTION IN THE LONG ISLAND SOUND — BUZZARDS BAY AREA

By Frances L. Parker

With Five Plates

CAMBRIDGE, MASS., U. S. A.
PRINTED FOR THE MUSEUM

May, 1952

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AT HARVARD COLLEGE

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No. 10.—*Foraminiferal Distribution in the Long Island Sound—Buzzards Bay Area*[1]

By Frances L. Parker

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[1] Received for publication October 8, 1951.

INTRODUCTION

The area investigated includes Long Island Sound south and east of the Housatonic River, Gardiners Bay, Block Island Sound, the approaches to Buzzards Bay and most of Buzzards Bay. The purpose of this investigation is to give the distribution of the Foraminifera and to analyze the faunal facies. Some of the physical characteristics of the environments will be described including salinity and temperature distribution and types of sediment. The types are deposited at the U. S. National Museum in Washington, D. C.

This investigation was supported by the Office of Naval Research (project number NR 081 050). Most of the samples were collected by H. C. Stetson and C. R. Hayes using the facilities of the Woods Hole Oceanographic Institution. Figures and tables were drafted by Misses J. F. Peirson and S. F. Rush. Miss Ruth Todd kindly compared specimens of *Elphidium incertum* (Williamson) with material at the National Museum.

LOCATION OF SAMPLES

The samples used in this survey were collected at various times and by different methods. Their positions are shown in figures 1 and 2. Table 1 gives geographic positions, depth, and type of sediment.

The stations may be divided into six groups as follows:

1. Long Island Sound. A series of samples was taken for about 3 miles up the Housatonic River (58–64); a second series from the mouth of the Housatonic River to the mouth of the Connecticut River (21–56); a third series south from the mouth of the Housatonic River to about the middle of the Sound at Lat. 41° 03.7′ N and then east to Long. 72° 30.4′ W (57–98); and a fourth series up the Connecticut River for about 7½ miles (1–20).

2. Gardiners Bay. Two series of samples were taken (99–115).

Groups 1 and 2 were collected in August, 1948, partly with an orange-peel dredge (Phleger, p. 320) and partly with the Phleger bottom sampler (Phleger, p. 321).

3. West of Fishers Island. This series extends south from the mouth of the Thames River (116–125). The samples were collected in the summer of 1942 with an underway bottom sampler designed by Ewing et al (1946, p. 925).

4. Block Island Sound. One series extends south from the east end of Fishers Island for about 5 miles (152–159); a second series extends along the southern shore of Fishers Island east to Long. 71° 32.6′ W and then south to a point just east of the mid-point of Block Island

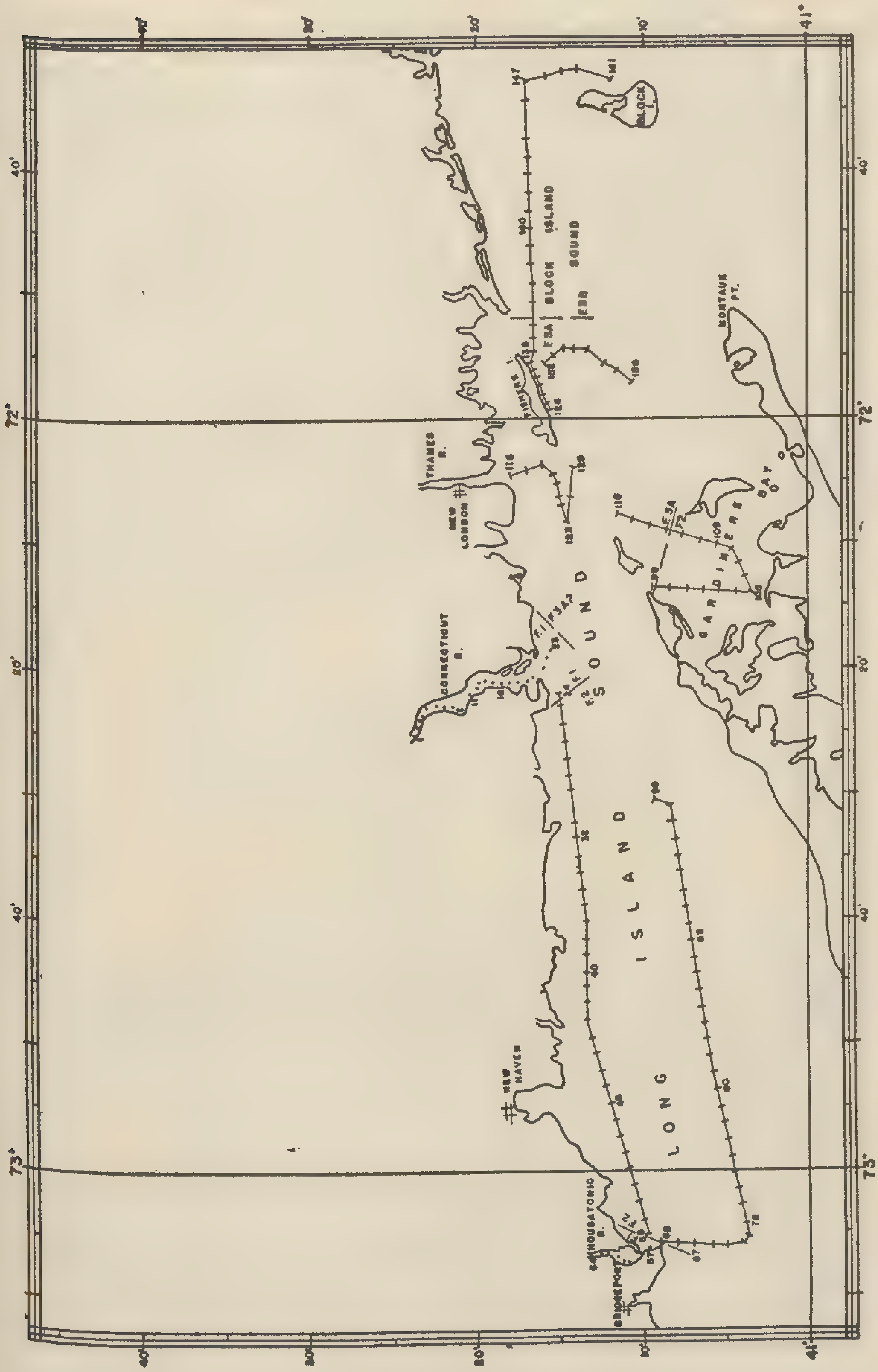
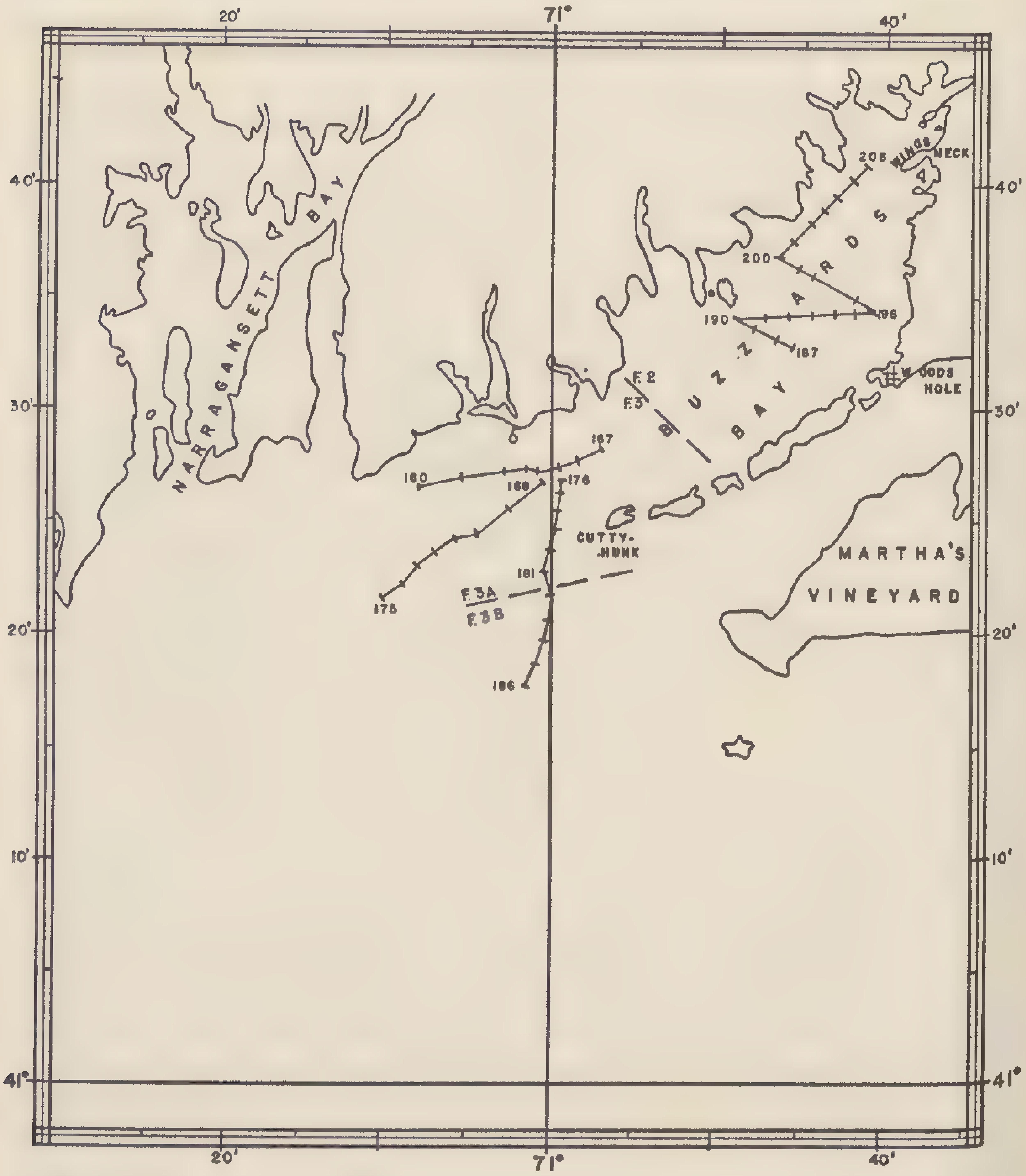

BLOCK I.
BLOCK ISLAND SOUND
FISHERS I.
THAMES R.
NEW LONDON
CONNECTICUT R.
NEW HAVEN
HOUSATONIC R.
BRIDGEPORT
MONTAUK PT.
GARDINERS BAY
LONG ISLAND SOUND
E3A
E3B
E3A?
E2
E1
72°
73°
41°
40'
20'
10'
30'

Fig. 1. Map of Long Island Sound and vicinity showing locations of stations and faunal facies boundaries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NARRAGANSETT BAY
BUZZARDS BAY
WINGS NECK
WOODS HOLE
CUTTY-HUNK
MARTHA'S VINEYARD
206
200
190
196
187
F.2
F.3
167
160
168
176
181
F.3A
F.3B
178
186

Fig. 2. Map of Buzzards Bay and vicinity showing locations of stations and faunal facies boundaries

(126–151). These samples were collected with the underway bottom sampler in the summer of 1942.

5. Approaches to Buzzards Bay. There are three series of samples converging in the mouth of the bay (160–186). They were collected in the summer of 1942 with the underway bottom sampler.

6. Buzzards Bay. The stations follow a zigzag course down the bay from a point in the center west of Wings Neck to a point about 8 miles southwest of the starting point (187–206). These samples were collected with a dwarf orange-peel bottom sampler in the summer of 1948.

METHODS OF STUDY

The samples were treated in a similar, though simplified, manner to that described in a previous paper (Parker, 1948, p. 217). They were subdivided to give an amount of material containing about 300 specimens. The samples taken with the underway bottom sampler sometimes contained less than this number without subdivision.

The Foraminifera were counted and percentages of the various species calculated and tabulated. Total population counts were calculated for those samples taken with the Phleger bottom sampler and orange-peel dredge. The samples taken with the underway bottom sampler were too variable in size to give comparative total populations. Tabulations of 150 of the 206 samples counted appear in Tables 2–6. Some species were found to have too scattered an occurrence to be of use in analysis. These have been omitted from the tables although some are listed elsewhere. Other species are too rare to appear in percentage counts and are considered to be of little immediate value in an ecologic study.

TEMPERATURE AND SALINITY DISTRIBUTION

The temperature and salinity data given below have been obtained from Sumner, Osborn and Cole (1911), Galtsoff and Loosanoff (1939), Riley (1948), and from records filed at the Woods Hole Oceanographic Institution.

Temperature

Minimum temperatures in Long Island Sound occur in February. West of the Connecticut River there is almost complete mixing of the water at this time giving a bottom temperature of about 1°C. An unusually warm winter might result in slightly higher temperatures but it is expected that this minimum would obtain during most years. In Gardiners Bay similar minimum temperatures probably occur although few data are available. Somewhat higher minimum temperatures of about 3°C. occur east of the Connecticut River. This 3°C. February bottom temperature extends eastward to the entrance of Buzzards Bay where the temperature drops to 1°C. For Buzzards Bay there are few data available for the period between November and March. From the conditions at the mouth of the bay, however, and by a comparison of the March figures for Buzzards Bay and Long Island Sound, it may be deduced that minimum bottom temperatures of 1°C. are to be expected. In such an area complete mixing and thus isothermal water would be expected during the winter months.

Maximum bottom temperatures occur during August. In western Long Island Sound a maximum of 21°C. is reached. To the eastward the temperature decreases to 18°C., the maximum observed south of the Connecticut River. It is probable that higher temperatures occur close to shore in very shallow water. The maximum bottom temperature in Gardiners Bay is probably about 21°C. In the region between Gardiners Bay and the mouth of the Thames River the maximum is 18°C. and this condition generally prevails in the western end of Block Island Sound. August bottom temperatures drop to about 15°C. toward the east in Block Island Sound, probably due to a marked surface thermocline and no deep mixing of the water. Between Block Island Sound and Cuttyhunk a maximum bottom temperature of only 13°C. is reached although the surface temperatures are slightly higher. At the entrance to Buzzards Bay the yearly maximum bottom temperature rises again to 18°C. Conditions in Buzzards Bay are similar to those of the western part of Long Island Sound with a maximum of about 18°C. near the entrance, increasing to 22°C. opposite Wings Neck.

Differences between yearly maximum and minimum temperatures in the various parts of the area are of interest. From west to east in Long Island Sound the difference varies from 20°C. to 17°C. From the Connecticut River eastward through Block Island Sound the difference decreases from 15°C. to 12°C. Between Block Island Sound and Cuttyhunk it is about 11°C., rising to 16°C. at the entrance to Buzzards Bay, and in Buzzards Bay it increases from 16°C. in the southwest to 21°C. in the northeast.

Salinity

Salinity in this area is essentially uniform during the year. The values are lowest in the spring and highest in the fall, the maximum variation probably not exceeding 2 $^0/_{00}$ (two parts per thousand). Salinity values in the western part of Long Island Sound near Bridgeport vary from 26–28 $^0/_{00}$ excluding the Housatonic River area. The salinity increases gradually eastward to a maximum in the area between Block Island and Cuttyhunk, of 32–33 $^0/_{00}$. In Buzzards Bay these values decrease again to 30–31 $^0/_{00}$ in the vicinity of Wings Neck.

At the entrance to the various rivers in Long Island Sound very complex and varying salinity patterns are found. Relatively fresh water frequently occurs at the surface and the salinity may increase as much as 4 $^0/_{00}$ with depth. In general bottom salinities close to 25 $^0/_{00}$ may be expected just outside the river mouths. Maximum bottom salinities of 28 $^0/_{00}$ at the Housatonic River and 30 $^0/_{00}$ at the Connecticut River have been observed. Surface salinities vary from 19 $^0/_{00}$ to 25 $^0/_{00}$ at the mouth of the Housatonic River and 15 $^0/_{00}$ to 26 $^0/_{00}$ at the mouth of the Connecticut River.

There are no published data on the salinities in the rivers. Dr. Gordon A. Riley of the Bingham Oceanographic Laboratory gives the following data (personal communication): "During August, 1946, I examined the salinity distribution about three miles up the Connecticut and Thames Rivers with the salinity-temperature-depth recorder. In each case the fresh water formed a sheet about five feet thick on the surface, underlain by a strong salinity gradient, with bottom salinities nearly the same as in the Sound outside. I would guess that high salinities can be found at the bottom as far up the rivers as the visible tidal effect. . . . However, there must be considerable variation with the tide, as well as seasonal change." These tidal effects extend up the rivers farther than any samples taken for this study.

BOTTOM SEDIMENTS

In Table 1 the character of the sediment at each station is given in general terms as sand, sand and mud, mud, and stony from examination of the samples, except in the case of the samples taken with the underway bottom sampler. For the interpretation of these samples, Stetson permitted the writer to examine his unpublished charts of sediment distribution in the Block Island-Cuttyhunk area.

The sediments are distributed in the expected manner with mud and sandy mud in the bays and sand on the continental shelf outside the bay areas, with local patches of mud. Sediments in Long Island Sound along the Connecticut shore are predominantly sand, or mud and sand. In the rivers sand is predominant. South of the Housatonic River there is an area of black mud. In the central part of the Sound a silty mud predominates, presumably material washed out from the rivers. Stations 93–99 in this part of the area, however, are in sand. Gardiners Bay contains sand and mud in most of the area sampled. Between Gardiners Bay and Buzzards Bay sand predominates, although there are large patches of mud scattered through the area. In Buzzards Bay there are mud and mud-sand patches.

DESCRIPTION OF FORAMINIFERAL FACIES

Figures 3 and 4 show the distribution of species in the various facies.

Facies 1

Facies 1 is developed best in the Connecticut River (sta. 1–24) and to a much lesser extent in the Housatonic River (sta. 57–64). The

——— PERSISTENT OCCURRENCE
- - - SCATTERED OCCURRENCE
- SINGLE OCCURRENCE

	FACIES 1		FACIES 2			FACIES 3	
						A	B
	HOUSATONIC RIVER	CONNECTICUT RIVER	LONG ISLAND SOUND	GARDINERS BAY	BUZZARDS BAY	TRANSITION ZONES	BLOCK ISLAND SOUND S.W. OF CUTTYHUNK
Ammoastuta salsa		- - -	-			-	
Ammobaculites cf. dilitatus					- - -		
A. cf. exiguus	-	- - -				-	
A. cf. foliaceus						- - -	———
Ammoscalaria fluvialis	-	- - -				-	
Bolivina pseudoplicata			- - -		- - -	———	———
B. variabilis		-	- - -	- - -	- - -	———	
Bulimina aff. aculeata						- - -	- - -
Cibicides concentricus						- - -	
C. lobatulus			- - -		-	———	- - -
Discorbis columbiensis			- - -	- - -	- - -	———	- - -
D. squamata						- - -	-
Eggerella advena		- - -	———	———	———	———	———
Elphidium advenum	-		-	- - -	———	———	-
E. advenum var. margaritaceum		-	- - -	- - -	- - -	———	- - -
E. excavatum			- - -	- - -	———	- - -	-
E. incertum & variants	———	- - -	———	———	———	———	———
E. incertum (heavy shell)			———	———	———	- - -	- - -
E. selseyense					- - -		
E. subarcticum	- - -		———	———	———	———	———
Eponides frigidus						- - -	———
E. frigidus var. calidus	- - -	-	———	———	———	———	- - -
E. wrightii			-	- - -	- - -	———	-
Globulina caribaea			- - -			- - -	-
Glomospira gordialis						- - -	-
Hopkinsina pacifica atlantica			- - -	- - -	- - -		
Labrospira crassimargo							———
Lagunculina vadescens		- - -					
Leptodermella variabilis	-	———					
Miliammina fusca	- - -	———	-		- - -	-	

Figure 3. Distribution of Foraminifera by faunal facies.

——— PERSISTENT OCCURRENCE - - - SCATTERED OCCURRENCE - SINGLE OCCURRENCE	FACIES 1		FACIES 2			FACIES 3	
						A	B
	HOUSATONIC RIVER	CONNECTICUT RIVER	LONG ISLAND SOUND	GARDINERS BAY	BUZZARDS BAY	TRANSITION ZONES	BLOCK ISLAND SOUND S.W. OF CUTTYHUNK
Nonion tisburyense		- - -	———	———	- - -	- - -	
Nonionella atlantica						- - -	-
Pninaella pulchella						- - -	
Poroeponides lateralis			- - -		-	———	- - -
Proteonina atlantica			- - -			———	———
P. hancocki	-	———					
P. lagenarium		———	- - -				
P. sp. A			- - -		———	-	
P. sp. B		- - -					
Pseudopolymorphina novangliae			- - -	- - -	- - -	- - -	- - -
Pyrgo striatella						———	- - -
Quinqueloculina seminula			- - -	- - -	- - -	———	- - -
Q. seminula var. jugosa			- - -	-	- - -	———	- - -
Q. subrotunda			- - -	-		———	- - -
Reophax curtus						- - -	———
R. dentaliniformis			———	———	- - -		
R. nana			- - -	———	———	- - -	
Rotalia beccarii			- - -	———	———	———	———
R. beccarii var. sobrina				———	———	- - -	
R. beccarii var. tepida			- - -	- - -	- - -	-	
Textularia cf. tenuissima		-	- - -	- - -	———	-	- - -
Triloculina brevidentata				- - -	———		
Trochammina compacta			- - -	- - -	———	- - -	- - -
T. inflata	- - -	-	-		- - -	- - -	
T. lobata		-	- - -	- - -	———	———	———
T. macrescens	-	- - -	-		-	-	
T. squamata	———	———	———	———	———	———	———
Urnulina compressa	-	———					
U. difflugaeformis		- - -					
Virgulina fusiformis					- - -	- - -	- - -

Figure 4. Distribution of Foraminifera by faunal facies.

species are exposed to great extremes of temperature. No temperature data are available but the extremes must be similar to those found in the western part of Long Island Sound: 1°C. to 21°C. Salinity also may be quite variable but values of near 25 $^0/_{00}$ probably obtain most of the time. During floods, and especially when floods coincide with neap tides, much lower salinities must occur.

The species confined to facies 1 are:

Ammoastuta salsa Cushman and Bronnimann
Ammobaculites cf. *exiguus* Cushman and Bronnimann
Ammoscalaria fluvialis n. sp.
Lagunculina vadescens Cushman and Bronnimann
Leptodermella variabilis n. sp.
Miliammina fusca (H. B. Brady) (some exceptions)
Proteonina hancocki Cushman and McCulloch
Proteonina lagenarium (Berthelin) (some exceptions)
Proteonina sp. B
Trochammina inflata (Montagu) (some exceptions)
Trochammina macrescens H. B. Brady (some exceptions)
Urnulina compressa Cushman
Urnulina difflugaeformis Gruber

It is of interest that this list contains species identical with, or resembling, those described by Cushman and Bronnimann (1948 a, b) from mangrove swamps in the river estuaries of the west coast of Trinidad. *Ammobaculites* cf. *exiguus* was described from a station, 0–4 m. in the Gulf of Paria, Trinidad. No further distribution data of this species have been published.

Analysis of this list of species shows that there is a possible mixing of facies. The majority of forms, as far as present evidence goes, live in water which presumably never reaches a salinity greater than 25 $^0/_{00}$. This is not true, however, of all the species present, such as *Miliammina fusca, Trochammina macrescens,* and *T. inflata.* These species occur in small numbers outside of facies 1, at a few scattered stations along the Connecticut shore (facies 2) south of the Thames River (facies 3), at one or two stations near Narragansett Bay (facies 3), and in the upper part of Buzzards Bay (facies 2). Most of these stations are very near the shore. Phleger and Walton (1950) found *M. fusca* and *T. inflata* in Barnstable marsh, the latter in great abundance. They were found only at a few stations outside the marsh, mostly near the outlet. The salinity of the water in Barnstable marsh is usually about 30 $^0/_{00}$, except after heavy rains. It seems probable that specimens of these species found in the present area have been derived from neighboring marshes and have been washed into the bays and possibly into the rivers as well. They appear to be able to survive a greater range of salinity than the other species indigenous to the rivers.

Although there are no samples taken from the Thames River, several species from facies 1 are found mixed with the facies 3 fauna outside its mouth. They are *Ammoastuta salsa*, *Ammobaculites* cf. *exiguus*, and *Ammoscalaria fluvialis*.

In the Connecticut River there are no Foraminifera at sta. 1–5 except for a single occurrence of *Proteonina lagenarium*. The facies is well developed at most of the remaining stations. Starting at sta. 13 the occurrence of *Eggerella advena* gives evidence of mixing with facies 3. *Elphidium incertum* has its first occurrence at sta. 15.

It is difficult to explain the poor development of facies 1 in the Housatonic River. It is possible that there is less outflow of water and more tidal effect in the area sampled which cause the water to be similar to that of the bay outside the mouth. There is a greater abundance of the species indigenous to Long Island Sound in this area than in the Connecticut River.

As at the mouth of the Thames River, there is some mixing of the facies 1 species with facies 2 near the mouths of the Connecticut and Housatonic Rivers.

Facies 2

Facies 2 is found in Long Island Sound as far east as the Connecticut River (sta. 25–56, 65–98), in Gardiners Bay (sta. 100–111) and in Buzzards Bay (sta. 187–206). There is some evidence of a gradual change from facies 2 to facies 3 in the central part of Long Island Sound, as indicated below in the discussion of facies 3. A transitional zone between facies 1 and 2 is found at the mouth of the Connecticut River from sta. 20–24.

The fauna in facies 2 is exposed to temperatures varying from 1°C. to 21°C., and at the outer limits the minimum temperature increases to 2°C. Salinities of 28–30 $^0/_{00}$ probably prevail with a seasonal variation of about 2 $^0/_{00}$. No data are available for Gardiners Bay but salinities taken at the bay entrance probably are indicative.

The species confined to facies 2 are:

Ammobaculites cf. *dilitatus* Cushman and Bronnimann (Buzzards Bay only)
Elphidium selseyensis (Heron-Allen and Earland) (Buzzards Bay only)
Hopkinsina pacifica atlantica Cushman
Nonion tisburyensis Butcher (some exceptions)
Proteonina sp. A

Reophax dentaliniformis H. B. Brady
Reophax nana Rhumbler
Rotalia beccarii (Linné) var. *tepida* Cushman (some exceptions)
Rotalia beccarii (Linné) var. *sobrina* Shupack (some exceptions)
Textularia cf. *tenuissima* Earland (some exceptions) [see footnote p. 458]
Triloculina brevidentata Cushman

In addition to the above species there are some that show a much greater abundance in this facies than elsewhere. A heavy-shelled variant of *Elphidium incertum* (Williamson) (pl. 4, figs. 1, 2) forms a large percentage of the fauna. This variant is also found in small numbers at a few scattered stations in facies 3 and occasionally in greater abundance, but in facies 2 it is very abundant except in the central area of Long Island Sound. *Trochammina compacta* n. sp. reaches its greatest abundance in facies 2 in Buzzards Bay.

The distribution of *Nonion tisburyensis* is of interest. It is found with some overlap into facies 1 at the mouth of the Connecticut River, but is best developed along the Connecticut shore and in Gardiners Bay. The occurrence in Buzzards Bay is scattered and it is almost absent from the central portion of Long Island Sound. It appears to be a transition species between facies 1 and 2.

The following species are the most abundant constituents of facies 2:

Eggerella advena (Cushman)
Elphidium incertum and/or variants
Elphidium subarcticum Cushman
Eponides frigidus (Cushman) var. *calidus* (Cushman and Cole)

Aside from the distribution of attached forms, discussed later, there is little indication of distribution controlled by sediments. The heavy-shelled variant of *Elphidium incertum* is frequently more abundant in mud than sand but not consistently so.

Facies 3

In the following discussion, facies 3 is divided, for convenience, into two parts: 3A being the transitional part of the facies and 3B its more complete development.

Facies 3A is found in the area between the Connecticut River and Gardiners Bay, extending eastward to 3 or 4 miles east of Fishers Island (sta. 99, 112–135, 152–159). It also occurs north and west of Cuttyhunk (sta. 160–181). Facies 3B is developed in Block Island Sound (sta. 136–151) and southwest of Cuttyhunk (sta. 182–186).

Facies 3A is transitional for the following reasons: (1) the species typical of facies 3 do not reach their full abundance, (2) one species typical of facies 3 is not found, (3) the "attached-form facies" reaches its greatest development, although it is present at occasional stations in facies 2 and facies 3B.

The temperature range in facies 3 is much less than that found in facies 1 and 2. The minimum temperature increases from 1°C. to 3°C., the latter obtaining in the facies 3B area. Similarly the maximum temperature decreases from 18°C. south of the Connecticut River to 13°C. in the area between Block Island and Cuttyhunk. It may be said, then, that for the best development of the facies in this area the temperature range is 3°C. to 15°C. The salinity between Block Island and Cuttyhunk ranges from 32–33 $^0/_{00}$. It is somewhat lower to the west but probably does not go lower than 30 $^0/_{00}$.

Species confined to facies 3 are:

Ammobaculites cf. *foliaceus* H. B. Brady (highest in 3B)
Bulimina aff. *aculeata* d'Orbigny
Cibicides concentricus (Cushman) (3A only)
Discorbis squamata Parker
Eponides frigidus (Cushman)
Globulina caribaea d'Orbigny (some exceptions)
Glomospira gordialis (Jones and Parker)
Labrospira crassimargo (Norman) (3B only)
Nonionella atlantica Cushman
Pninaella (?) *pulchella* Parker (3A only)
Proteonina atlantica Cushman (highest in 3B)
Pyrgo striatella (Cushman)
Reophax curtus Cushman (highest in 3B)
Virgulina fusiformis (Williamson) (some exceptions)

It is probable that *Discorbis squamata* and *Pninaella* (?) *pulchella* should not be considered as typical representatives of facies 3. Little is known as yet of their distribution in other areas and their occurrence in facies 3 is slight and inconclusive.

Two additional species: *Planulina mera* Cushman and *Quinqueloculina arctica* Cushman occur rarely in facies 3, but are not listed in the tables.

It is interesting to contrast facies 3 with the second depth facies, 15–90 m., found on the continental shelf south of Cape Cod (Parker, 1948). This continental shelf facies is identical in its main constituents with facies 3 in the Long Island Sound-Buzzards Bay area, which is to be expected. Certain forms found only in that facies on the continental shelf are found throughout the present area except in facies 1. These forms include: *Quinqueloculina seminula* (Linné), *Q. seminula* var. *jugosa* Cushman, *Eggerella advena* (Cushman), and *Trochammina lobata* Cushman. Other species of continental shelf facies 2 found in the present facies 3 only include: *Cibicides concentricus, Globulina caribaea, Nonionella atlantica, Labrospira crassimargo,* and *Pyrgo striatella.* Some of the species found in facies 3 only occur in all facies of the continental shelf and slope to a depth of at least 600 m. These include: *Eponides frigidus, Proteonina atlantica, Reophax curtus,* and *Virgulina fusiformis.* It is of interest that the temperature limits of continental shelf facies 2 are 3°C. to 16°C. which are almost identical with those encountered in facies 3. The salinity varies from 31 $^0/_{00}$ to 34.6 $^0/_{00}$, which is somewhat higher than that found in facies 3.

Facies 3A contains the best development of attached forms. The species concerned are:

Cibicides lobatulus (Walker and Jacob)
Discorbis columbiensis Cushman
Poroeponides lateralis (Terquem)
Quinqueloculina subrotunda (Montagu)

It is possible that *Eponides wrightii* (H. B. Brady) should be included with this group as well as other species of Miliolidae.

These species are found on sandy or stony bottoms, which most commonly occur in the facies 3A area. The specimens are frequently attached to algae which grow best in such areas (Davis, 1911 (1913), p. 481). The attached fauna is best developed south of the Thames River and along the southern shore of Fishers Island (sta. 114, 115, 120–134). It also occurs abundantly at sta. 151 in facies 3B close to the shore of Block Island and at sta. 162 northwest of Cuttyhunk. The depths at these stations vary from 7–76 m. Cushman (1944, pp. 15, 34, 36) points out that the attached forms found in great abundance on beaches in this general area have been washed on shore attached to algae. There is a possibility that specimens have been washed into the present locations on algae as well. It seems more probable, however, considering that 75 per cent of the stations occur at a depth of 14 m. or more, that the species are living where they are found. These species form 70 per cent of the fauna at sta. 114 and at two-thirds of the stations listed above form 35 per cent or more of the fauna.

Aside from the great abundance of the attached forms in discrete areas the most abundant constituents of facies 3 are:

Eggerella advena
Elphidium subarcticum
Rotalia beccarii (3A mostly)

Eponides frigidus (3B mostly)
Eponides frigidus var. *calidus* (3A mostly)
Proteonina atlantica (sta. 135–181)

These species, except *R. beccarii* and *E. frigidus* var. *calidus,* occur on the continental shelf and adjacent slope south of Cape Cod although *E. advena* is confined to depths of less than 90 m.

Although the central part of Long Island Sound has been placed in facies 2, there is evidence that the transition to facies 3 begins in this area. A few specimens of *Proteonina atlantica* and *Globulina caribaea* occur here. In addition the heavy-shelled variant of *Elphidium incertum,* usually a most important constituent of facies 2, is not present in great abundance. In other respects, however, the area is more typical of facies 2.

DISCUSSION OF SPECIES

Fifty-seven benthonic species are included in the analysis of the area and each of these is discussed below. Only a few juvenile planktonic forms were found. The following benthonic species are omitted from the discussions as they occur only at scattered stations at very low percentages:

Armorella sphaerica Heron-Allen and Earland (facies 2)
Bolivina cf. *striatula* Cushman (facies 2, 3)
Buliminella elegantissima (d'Orbigny) (facies 2, 3)
Cornuspira planorbis Schultze (facies 2, 3)
Elphidium cf. *discoidale* (d'Orbigny) (facies 2, 3)
Patellina corrugata Williamson (facies 2, 3)
Planulina mera Cushman (facies 3 — one exception)
Quinqueloculina angulata (Williamson) (facies 2, 3)
Quinqueloculina arctica Cushman (facies 3)
Quinqueloculina lata (Terquem) (facies 2, 3)
Reophax scottii Chaster (facies 2, 3)

An intensive description of the relationship of this fauna to those north and south of the area is of little value because of insufficient data. Little work has been done on bay faunas to the south although there are considerable data on such faunas north of Cape Cod. The following notes are of some interest.

The following 6 species have not been reported elsewhere:

Ammoscalaria fluvialis n. sp.
Trochammina compacta n. sp.
Hopkinsina pacifica atlantica Cushman.

Leptodermella variabilis n. sp.
Proteonina sp. A
Proteonina sp. B

Five species are reported in the western Atlantic for the first time:

Elphidium selseyensis (Heron-Allen and Earland)
Proteonina lagenarium (Berthelin)
Reophax nana Rhumbler
Textularia cf. *tenuissima* Earland [see footnote p. 458]
Urnulina difflugaeformis Gruber

The Pacific species *Proteonina hancocki* Cushman and McCulloch has not been previously reported in the Atlantic.

Four species resembling those reported by Cushman and Bronnimann (1948a, b) from Trinidad are reported for the first time in this area:

Ammoastuta salsa
Ammobaculites cf. *dilitatus*
Ammobaculites cf. *exiguus*
Lagunculina vadescens

This is the first report of the following 7 species from south of Cape Cod:

Discorbis squamata Parker
Elphidium excavatum (Terquem)
Miliammina fusca (H. B. Brady)
Pninaella (?) *pulchella* Parker
Quinqueloculina arctica Cushman (rare)
Trochammina macrescens H. B. Brady
Urnulina compressa Cushman

Seven additional species have not been reported north of Cape Cod:

Cibicides concentricus (Cushman)
Elphidium advenum (Cushman)
Globulina caribaea d'Orbigny
Nonion tisburyensis Butcher
Nonionella atlantica Cushman
Poroeponides lateralis (Terquem)
Quinqueloculina seminula (Linné) var. *jugosa* Cushman

Cape Cod apparently forms an effective barrier for about one-third of the species, although this number may be reduced by future investigation.

The notes on individual species stress distribution although some taxonomic notes are included. More detailed information about the taxonomy of many of the species can be found in Parker's (1952, p. 393) paper on the taxonomy of the Foraminifera off Portsmouth, New Hampshire.

AMMOASTUTA SALSA Cushman and Bronnimann

(Plate 2, figures 1, 2)

Ammoastuta salsa Cushman and Bronnimann, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 1, p. 17, pl. 3, figs. 14–16.

This species is confined to facies 1. It occurs in the Connecticut River samples and in a few samples along the Connecticut shore where the occasional specimens have probably been carried out from the river. It is also found at sta. 116 near the mouth of the Thames River. It appears to be confined to brackish water and is so reported from various localities.

AMMOBACULITES cf. DILITATUS Cushman and Bronnimann

(Plate 1, figure 23)

Ammobaculites dilitatus Cushman and Bronnimann, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 2, p. 39, pl. 7, figs. 10, 11.

This form occurs only in facies 2 in Buzzards Bay. It is a very loosely cemented species, which may account for its rarity in washed samples. Unbroken specimens are seldom found.

AMMOBACULITES cf. EXIGUUS Cushman and Bronnimann

(Plate 1, figures 16, 17)

Ammobaculites exiguus Cushman and Bronnimann, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 2, p. 38, pl. 7, figs. 7, 8.

This species is too rare to be identified with certainty. It is found in the Connecticut and Housatonic Rivers and at one station at the mouth of the Thames River. It appears to be larger than the Cushman and Bronnimann species but is otherwise similar. Both this species and *A.* cf. *dilitatus* are only reported from shallow water in the Gulf of Paria, Trinidad.

AMMOBACULITES cf. FOLIACEUS (H. B. Brady)

(Plate 1, figures 20, 21)

Haplophragmium foliaceum H. B. Brady, 1881, Jour. Micr. Sci., vol. 21, p. 50; 1884, Rept. Voy. CHALLENGER, Zool. vol. 9, p. 304, pl. 33, figs. 20–25.

This form is confined to facies 3 where it forms as much as 7 per cent of the fauna.

AMMOSCALARIA FLUVIALIS n.sp.

(Plate 1, figures 24, 25)

Test small, compressed, with about 6 chambers in the final whorl in the planispiral portion which composes most of the test in the microspheric form, uncoiled portion with 4 or 5 chambers in the megalospheric form; chambers increasing gradually in size as added; segmentation very indistinct; wall somewhat rough, composed of small sand grains which are well cemented together; aperture oval, at the end of a very short neck or constricted portion at the apex of the test. Length up to 0.5 mm.; width up to 0.3 mm.; thickness up to 0.11 mm.

Holotype from sta. 59 in the Housatonic River at a depth of 3 m., Lat. 41° 10.9′ N, Long. 73° 07.3′ W.

This species resembles *Ammobaculites salsus* Cushman and Bronnimann but differs in having a more pronounced uniserial portion, less inflated chambers, and less distinct segmentation. It has fewer chambers than *Ammoscalaria runiana* (Heron-Allen and Earland), is more compressed, with a less broadly rounded periphery. The thin, chitinous septae dividing the chambers can be plainly seen when specimens are immersed in oil of aniseed, a technique recommended by Höglund (1947, p. 18).

A. fluvialis is confined to facies 1, occurring in both the Connecticut and Housatonic Rivers and forming as much as 18 per cent of the fauna at sta. 59 in the latter. There is a single occurrence at the mouth of the Thames River.

BOLIVINA PSEUDOPLICATA Heron-Allen and Earland

(Plate 4, figure 11)

Bolivina pseudoplicata Heron-Allen and Earland, 1930, Jour. Roy. Micr. Soc., vol. 50, p. 81, pl. 3, figs. 36–40.

B. pseudoplicata occurs at scattered localities in facies 2 but is more common in facies 3 where it reaches a maximum of 6 per cent of the fauna. It is confined to depths between 15 m. and 90 m. on the adjacent continental shelf (Parker, 1948, p. 221).

BOLIVINA VARIABILIS (Williamson)

(Plate 4, figure 12)

Textularia variabilis Williamson, 1858, Rec. Foram. Great Britain, p. 76, pl. 6, figs. 162, 163.

This species is found in facies 2 and 3 but is more persistent in the transition zone of facies 3 (3A). It is mostly confined to sand or sand and mud.

BULIMINA aff. ACULEATA d'Orbigny

(Plate 4, figures 7, 13)

Bulimina aculeata d'Orbigny, 1826, Ann. Sci. Nat., vol. 7, p. 269, No. 7.

This species resembles *B. patagonica* d'Orbigny var. *glabra* Cushman and Wickenden in the shape of the chambers which are less globular and more elongate than in typical *B. aculeata*. It differs in the presence of occasional spines at the base of the chambers. It is a small form not exceeding 0.4 mm. in length and is found in small quantities in facies 3. A few specimens of typical *B. aculeata* and the related species *B. marginata* d'Orbigny also occur in this facies but are not listed in the tables.

CIBICIDES CONCENTRICUS (Cushman)

(Plate 5, figures 10a, b)

Truncatulina concentrica Cushman, 1918, U. S. Geol. Surv. Bull. 676, p. 64, pl. 21, fig. 3.

This species is confined to transition facies 3A, chiefly in the area west of Cuttyhunk, where it occurs at low frequencies. The species has an unusual distribution elsewhere along the continental shelf south of Cape Cod (Parker 1948, p. 222) occurring at depths of 36 m. or less off the New Jersey coast and 68 m. or less off Maryland. Off Block Island and Martha's Vineyard it is found only rarely, not occurring in sufficient numbers to appear in frequency counts of the samples. Its absence from this area and from facies 3B in Block Island Sound and southwest of Cuttyhunk is difficult to explain. The species is common south of Cape Hatteras and it is possible that it requires the slightly higher maximum temperatures found in facies 3A for its reproduction. This would be in agreement with the observations made by Myers (1935, p. 358) in the case of *Patellina corrugata* Williamson.

Cibicides lobatulus (Walker and Jacob)

(Plate 5, figures 11a, b)

Nautilus lobatulus Walker and Jacob, 1798, Adams Essays, Kanmachers' ed., p. 642, pl. 14, fig. 36.

This species is found in the eastern part of Long Island Sound in facies 2 and very rarely in Buzzards Bay. Its chief occurrence is in facies 3A where it has the same distribution as the other attached forms, reaching frequencies up to 9 per cent in the vicinity of Fishers Island.

Discorbis columbiensis Cushman

(Plate 4, figures 17a, b, 18a, b, 19a, b, 20a, b)

Discorbis columbiensis Cushman, 1925, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, p. 43, pl. 6, figs. 13a-c.

D. columbiensis is found in facies 2 and 3. It occurs in large numbers especially at nearshore stations. It is an attached form and is, therefore, most abundant in sandy and stony areas. At sta. 115 it forms 53 per cent of the fauna but usually reaches percentages only half as great at the localities where it most commonly occurs. It is reported from this area by Cushman (1944) under several names owing, probably, to its highly variable character.

Discorbis squamata Parker

(Plate 5, figures 1a, b)

Discorbis squamata Parker, 1952, Bull. Mus. Comp. Zoöl., vol. 106, no. 9, p. 418, pl. 6, figs. 10a, b, 11.

A few of the specimens, of which one is figured, are larger and have one to two more chambers than those obtained at the type locality in the Portsmouth area of the Gulf of Maine. The species occurs in facies 3, chiefly in the transition zone, at very low percentages.

EGGERELLA ADVENA (Cushman)

(Plate 2, figure 3)

Verneuilina advena Cushman, 1921 (1922), Contr. Canadian Biol., no. 9, p. 141.
Verneuilina polystropha Cushman (not Reuss) 1920, Rept. Canadian Arctic Exped., vol. 9, pt. M, p. 8, pl. 1, fig. 5.

This species is widely distributed throughout the area. In facies 1 it does not occur beyond sta. 13 up the Connecticut River and is absent from the Housatonic River. It is irregular in its frequency distribution but there seems to be no definite correlation with type of sediment. In general it is more abundant in samples where mud is present but there are exceptions. The species forms as much as 76 per cent of the fauna at one station in Buzzards Bay. It is confined to depths shallower than 90 m. on the adjacent continental shelf (Parker, 1948, p. 221).

ELPHIDIUM ADVENUM (Cushman)

(Plate 3, figure 9)

Polystomella advena Cushman, 1922, Publ. 311, Carnegie Instit. Washington, p. 56, pl. 9, figs. 11, 12.

Specimens from this area are less broadly carinate than those from the Tortugas. They are also smaller, the largest having a diameter of 0.43 mm. This is apparently the northern limit of distribution of this species and it is possible that the conditions are not favorable for its typical development. It is found in facies 2 and 3A with single occurrences in the other facies. It occurs chiefly in sand or mud and sand.

ELPHIDIUM ADVENUM (Cushman) var. MARGARITACEUM Cushman

(Plate 3, figure 10)

Elphidium advenum (Cushman) var. *margaritaceum* Cushman, 1930, Bull. 104, U. S. Nat. Mus., pt. 7, p. 25, pl. 10, fig. 3.

This variety is found in facies 2 and less commonly in facies 3. With the exception of one occurrence it is not found west of sta. 90 in Long Island Sound. It is most abundant in sand and forms as much as 11 per cent of the fauna.

ELPHIDIUM EXCAVATUM (Terquem)

(Plate 3, figure 13)

Polystomella excavata Terquem, 1875, Essai. Class. Anim. Dunkerque, p. 25, pl. 2, figs. 2a-f.

E. excavatum is confined mostly to facies 2, although it occurs in transition facies 3A in the Cuttyhunk area, where some mixing of facies probably occurs.

ELPHIDIUM INCERTUM (Williamson) and variants

(Plate 3, figures 14, 16, 17; plate 4, figures 1, 2)

Polystomella umbilicatula Walker and Boys var. *incerta* Williamson, 1858, Rec. Foram. Great Britain, p. 44, pl. 3, fig. 82a.

This is a very variable species in this area. Cushman's variety *clavatum* has been included under this general heading and it is probable that most of the specimens come closer to this designation than to Williamson's species. Extreme cases of the variations can be easily differentiated but when an attempt is made to separate specimens picked at random it becomes evident that the range of variation is continuous. Taken as a group the species forms the largest percentage of the fauna at most of the stations, constituting up to 90 per cent of the fauna at some stations in facies 2. In facies 3, however, it is also very common at some stations. In facies 1 it occurs in all the Housatonic River stations but not beyond sta. 15 in the Connecticut River. There is a large, thick, heavy-shelled variant, confined chiefly to facies 2, having limbate sutures which often develop heavy retral processes. Some of the specimens have supplementary apertures on the apertural face characteristic of *Cribroelphidium* but this feature is not universal. Treatment with acid to remove the outer whorls reveals a young form apparently identical with the simpler, typical form of the *clavatum* variant. It usually occurs in sediments containing at least some mud. At sta. 65–67, composed of black mud with a presumably high organic content, it was found in very large quantities to the exclusion of almost everything else. It is interesting that this variant does not occur, except in small quantities, in the central part of Long Island Sound. The chief areas of occurrence are Gardiners Bay, Buzzards Bay, a few stations along the Connecticut shore between the Connecticut and Housatonic Rivers, and several stations south of the Housatonic River.

The variants of *E. incertum* have been included under one heading in the tables and figures. In addition the occurrence of the heavy-shelled variant is given in figure 3. *E. incertum* is reported from all depths on the adjacent continental shelf and slope to a depth of 600 m. (Parker 1948) but no specimens of the heavy-shelled variant were observed.

ELPHIDIUM SELSEYENSIS (Heron-Allen and Earland)

(Plate 4, figure 9)

Polystomella striatopunctata (Fichtel and Moll) sp., Heron-Allen and Earland, 1909, Roy. Micr. Soc. Jour., p. 695, pl. 21, figs. 2a-c.

Polystomella striatopunctata (Fichtel and Moll) var. *selseyensis* Heron-Allen and Earland, 1911, ibid, p. 448.

This species is found in facies 2 in Buzzards Bay. The only previous record accompanied by figures is from the Selsey shore sand, England. Its restriction to Buzzards Bay cannot yet be explained.

ELPHIDIUM SUBARCTICUM Cushman

(Plate 4, figures 3–6, 8)

Elphidium subarcticum Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 27, pl. 3, figs. 34, 35.

This form occurs in all facies. The specimens in facies 1, however, are stunted and occur at low frequencies. This suggests that this environment is unfavorable for their development. This species forms as much as 30 per cent of the fauna and is somewhat more abundant in sand samples than in mud although it is by no means confined to sand areas. Some change, however, can be seen in regions where there are adjacent sand and mud bottoms, although not invariably so. It occurs in all facies of the adjacent continental shelf and slope (Parker, 1948).

EPONIDES FRIGIDUS (Cushman)

(Plate 5, figures 2a, b)

Pulvinulina frigida Cushman, 1921 (1922), Contr. Canadian Biol., p. 12.

Pulvinulina repanda (Fichtel and Moll) var. *karsteni* Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 396, pl. 14, figs. 14, 15, 17.

This species occurs in facies 3, where it forms as much as 10 per cent of the fauna in the Block Island Sound area. It is less common in the Cuttyhunk region. On the adjacent continental shelf and slope it is reported as *E. frigidus* var. *calidus* in all facies (Parker, 1948, p. 238).

EPONIDES FRIGIDUS (Cushman) var. CALIDUS Cushman and Cole

(Plate 5, figures 3a, b)

Eponides frigida (Cushman) var. *calida* Cushman and Cole, 1930, Contr. Cushman Lab. Foram. Res., vol. 6, pt. 4, p. 98, pl. 13, fig. 13.

This is a widely distributed variety in the area, occurring in all facies. It reaches its highest frequency in Long Island Sound with a percentage of 40 per cent. It is largely replaced in the well-developed part of facies 3 by *E. frigidus*. It is reported only from bays in this area and north of Cape Cod.

EPONIDES WRIGHTII (H. B. Brady)

(Plate 5, figures 4a, b)

Discorbina wrightii H. B. Brady, 1881, Ann. Mag. Nat. Hist., ser. 5, vol. 8, p. 413, pl. 21, figs. 6a-c.

E. wrightii is widely distributed except in facies 1. It is most common in the transition zone of facies 3 in Long Island Sound north of Gardiners Bay and off Fishers Island, with occurrences of 10 per cent and 12 per cent respectively. It is rare in western Long Island Sound and Buzzards Bay. It appears to follow the same pattern of occurrence as the various attached forms being generally restricted to sandy or stony areas, but there is no direct evidence that it is an attached form. Specimens are frequently observed in plastogamic pairs.

GLOBULINA CARIBAEA d'Orbigny

(Plate 3, figure 6)

Globulina caribaea d'Orbigny, 1839, in De la Sagra, Hist. Phys. Pol. Nat. Cuba, p. 135, pl. 2, figs. 7, 8.

This species is found at low frequencies in facies 3 and in facies 2 in the central part of Long Island Sound at sta. 91–97. It is confined to depths of 15 m. to 90 m. on the adjacent continental shelf (Parker, 1948, p. 221).

GLOMOSPIRA GORDIALIS (Jones and Parker)

(Plate 1, figure 13)

Trochammina squamata Parker and Jones var. *gordialis* Jones and Parker, 1860, Quart. Jour. Geol. Soc., vol. 16, p. 304; Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 408, pl. 15, fig. 32.

This species occurs at low frequencies in facies 3.

HOPKINSINA PACIFICA ATLANTICA Cushman

(Plate 4, figures 14–16)

Hopkinsina pacifica Cushman var. *atlantica* Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 30, pl. 4, fig. 1.

It has not been possible to compare the types of Cushman's species and variety but there appears to be a close resemblance between them. Their relationship cannot be varietal owing to their wide geographic separation. Even a subspecific relationship is unlikely but further information on the distribution of the two forms may clarify this. *H. pacifica atlantica* is confined to facies 2 except at sta. 113 (facies 3). It is most abundant in Gardiners Bay and Buzzards Bay, attaining frequencies of 1 per cent. The only previous record is Cushman's from 11 m. in Vineyard Sound.

LABROSPIRA CRASSIMARGO (Norman)

(Plate 1, figure 22)

Haplophragmium crassimargo Norman, 1892, Mus. Normanianum, pt. 8, p. 17.
Haplophragmium canariense Brady, 1884, (part) (not d'Orbigny), Rept. Voy. CHALLENGER, Zool., vol. 9, p. 310, pl. 35, fig. 4 (not figs. 1–3, 5).
Haplophragmoides major Cushman, 1920, Bull. 104, U. S. Nat. Mus., pt. 2, p. 39, pl. 8, fig. 6.

This species is found in facies 3B where it forms as much as 4 per cent of the fauna. On the adjacent continental shelf it is reported as *Haplophragmoides major* at depths shallower than 90 m. off Block Island and rarely at comparable depths farther south (Parker, 1948, p. 222). The species is found in the Arctic ranging southward to the area immediately south of Cape Cod which is apparently close to its southern limit of occurrence.

LAGUNCULINA VADESCENS Cushman and Bronnimann

(Plate 1, figure 8)

Lagunculina vadescens Cushman and Bronnimann, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 1, p. 15, pl. 3, figs. 1, 2.

L. vadescens is very rare. Single specimens are found at a few stations in the Connecticut River in facies 1. The only previously reported occurrence is Cushman and Bronnimann's from a river estuary in Trinidad.

LEPTODERMELLA VARIABILIS n.sp.

(Plate 1, figures 11a, b, 12)

Test small, round to oval in transverse section, ventral side concave and compressed about the aperture, inflated below, dorsal side variably convex, more convex toward the lower part of the test; wall thin, composed of chitin usually overlain by a layer of fine sand grains of variable thickness, chitinous forms smooth, those with sand grains slightly rough; aperture round, in the upper half of the ventral side of the test, the wall around it bent in to form a raised, collar-like projection on the inner side of the test. Maximum diameter 0.29 mm.

Holotype from sta. 24, Long Island Sound, southwest of the mouth of the Connecticut River at a depth of 6½ m., Lat. 41° 15.4′ N, Long. 72° 21.8′ W.

This is the only described species of the genus having an asymmetrical pouch-like test. In this respect it resembles the genus *Marsupulina* Rhumbler. As in *L. excentrica* Cushman and Bronnimann, the aperture is placed at the upper part of the ventral side of the test but in *L. variabilis* it is circular instead of elongate. This is the only described species having a circular aperture. The variable character of the wall of the test is an unusual feature. Some specimens are almost entirely chitinous while others have a fairly heavy arenaceous coating, with a continuous gradation between the two.

The species occurs in facies 1 in the Connecticut and Housatonic Rivers and at some stations outside the mouth of the Connecticut River. It has a maximum frequency of 30 per cent. The large number of specimens found at sta. 24 may be due to deposition from the river.

MILIAMMINA FUSCA (H. B. Brady)

(Plate 2, figures 6a, b)

Quinqueloculina fusca H. B. Brady, 1870, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 47, pl. 11, figs. 2a-c, 3.

This species occurs chiefly in facies 1 but is rare in facies 2 in what may be a transition area between the two facies. Its distribution in facies 2 is along the Connecticut shore adjacent to the rivers, at sta. 171 near Narragansett Bay, and in the upper part of Buzzards Bay at sta. 197–206. It differs from most other species characteristic of facies 1 in its apparent ability to exist in water of higher salinity. Phleger and Walton (1950, p. 280), found it in Barnstable Harbor and at a few stations in Cape Cod Bay where there is a maximum salinity of 32 $^0/_{00}$. It is possible that occurrences in facies 2, all of which are at nearshore stations, are caused by outwash from marshes.

NONION TISBURYENSIS Butcher

(Plate 3, figures 7, 8)

Nonion tisburyensis Butcher, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 1, p. 22, text figs. 1–3.

This species is mostly confined to facies 2 with some overlap into facies 1. It is also found in facies 3A at the mouth of the Thames River and at one station west of Cuttyhunk. It apparently tolerates water of salinities varying from 20 $^0/_{00}$ to 30 $^0/_{00}$. This agrees with the reported occurrences of the species in Great Pond, Falmouth, and Tisbury Great Pond on Martha's Vineyard.

NONIONELLA ATLANTICA Cushman

(Plate 3, figures 15a, b)

Nonionella atlantica Cushman, 1947, Contr. Cushman Lab. Foram. Res., vol. 23, pt. 4, p. 90, pl. 20, figs. 4, 5.

Nonionella atlantica is found in small quantities in facies 3. This is apparently the species figured by Cushman (1944, p. 25, pl. 3, figs. 26, 27) as *N. auricula* Heron-Allen and Earland although that species has been observed very rarely in this area also. *N. atlantica* is reported on the continental shelf south of Cape Cod as *Nonion sloanii* (d'Orbigny) by Parker (1948, p. 222) in water shallower than 90 m. off the coast of Maryland with rare occurrences at similar depths farther north.

PNINAELLA (?) PULCHELLA Parker

(Plate 5, figures 9a, b)

Pninaella (?) *pulchella* Parker, 1952, Bull. Mus. Comp. Zoöl., vol. 106, no. 9, p. 420, pl. 6, figs. 18a, b, 19, 20.

This species occurs at low percentages in the transition area of facies 3.

POROEPONIDES LATERALIS (Terquem)

(Plate 5, figures 6a, b)

Rosalina lateralis Terquem, 1878, Mém. Soc. Géol. France, sér. 3, vol. 1, Mém. 3, p. 25, pl. 2, figs. 11a-c.

This form is found in all facies except facies 1, occurring most abundantly in facies 3A south of the Thames River and Fishers Island, where it forms as much as 28 per cent of the fauna. It is an attached form and follows the same pattern of occurrence as the other attached forms found in the area, being confined to sandy and stony sediments.

PROTEONINA ATLANTICA Cushman

(Plate 1, figures 1, 2)

Proteonina atlantica Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 5, pl. 1, fig. 4.

P. atlantica occurs in facies 2 and 3. In facies 2 it is confined to the central part of Long Island Sound where it occurs at very low percentages. The highest percentages are found in facies 3, reaching a maximum of 61 per cent. The species is widely distributed on the continental shelf and adjacent slope south of Cape Cod where it is listed by Parker (1948, p. 239) as *P. difflugiformis* (combined with "*Reophax scorpiurus* Montfort").

PROTEONINA HANCOCKI Cushman and McCulloch

(Plate 1, figure 3)

Proteonina hancocki Cushman and McCulloch, 1948, Contr. Cushman Lab. Foram. Res., vol. 24, pt. 3, p. 76.

Proteonina compressa Cushman and McCulloch (not Paalzow), 1939, Allan Hancock Pacific Exped., vol. 6, no. 1, p. 42, pl. 1, fig. 10.

This species occurs in facies 1 in the Connecticut River, with one occurrence in the Housatonic River, forming as much as 20 per cent of the fauna. The only previous report is from its type locality at Ketchikan, Alaska, at a depth of 15 m.

PROTEONINA LAGENARIUM (Berthelin)

(Plate 1, figures 4, 5)

Haplophragmium lagenarium (Berthelin), 1880, Mém. Soc. Géol. France, ser. 3, vol. 1, no. 5, p. 21, pl. 4, figs. 2a, b.

P. lagenarium is relatively abundant in facies 1 in the Connecticut River and occurs at lower percentages in facies 2 along the Connecticut shore. Many reports of this species are not reliable.

PROTEONINA sp. A

(Plate 1, figure 6)

This species occurs at very low percentages in facies 2 in the central area of Long Island Sound and in Buzzards Bay. It is smaller than *P. atlantica,* less contracted at the apertural end, and more finely arenaceous. It is possible that it is a variant of that species occurring in environments at the limits of its tolerance.

PROTEONINA sp. B

(Plate 1, figure 7)

This is probably a new species but is not found in sufficient numbers to warrant description. It is very small, being less than 0.2 mm. in length. It occurs in facies 1, in the Connecticut River.

PSEUDOPOLYMORPHINA NOVANGLIAE (Cushman)

(Plate 3, figures 11, 12)

Polymorphina lactea (Walker and Jacob) var. *novangliae* Cushman, 1923, Bull. 104, U. S. Nat. Mus., pt. 4, p. 146, pl. 39, figs. 6–8.

This species occurs at low percentages in all facies except facies 1. It does not occur in Long Island Sound except at a few isolated localities. The consistent occurrence is found in Gardiners Bay and the areas to the north and east and in Buzzards Bay. It is probable that the reference to *Guttulina lactea* in this region refers to young forms of *P. novangliae*. The species is found in all facies on the continental shelf and adjacent slope to the south but is almost entirely confined to depths less than 300 m. (Parker, 1948, p. 238).

PYRGO STRIATELLA (Cushman)

(Plate 2, figure 12)

Biloculina ringens (Lamarck) var. *striatella* Cushman, 1908, Proc. Boston Soc. Nat. Hist., vol. 34, p. 25, pl. 5, fig. 1.

P. striatella occurs in facies 3, being most common in the transition area where it reaches a frequency of 2 per cent. It is found at depths of less than 90 m. on the adjacent continental shelf (Parker, 1948, p. 222).

QUINQUELOCULINA SEMINULA (Linné)

(Plate 2, figures 7a, b)

Serpula seminulum Linné, 1758, Syst. Nat., ed. 10, p. 786.

This species occurs in all facies except facies 1. It reaches its most regular and abundant occurrence in facies 3A where it forms as much as 8 per cent of the fauna. It is not found in the western part of Long Island Sound. There seems to be some tendency for the species to be confined to sandy areas although this is not consistently true. It is confined to depths of less than 90 m. on the adjacent continental shelf (Parker, 1948, p. 221).

QUINQUELOCULINA SEMINULA (Linné) var. JUGOSA Cushman

(Plate 2, figures 8a, b)

Quinqueloculina seminula (Linné) var. *jugosa* Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res. p. 13, pl. 2, fig. 15.

This form is found in all facies except facies 1, but does not occur in Long Island Sound west of sta. 96. It is most common in facies 3A where it reaches frequencies of 5 per cent. It occurs chiefly on sandy or stony bottoms. On the adjacent continental shelf it occurs at depths of less than 90 m. (Parker, 1948, p. 222).

QUINQUELOCULINA SUBROTUNDA (Montagu)

(Plate 2, figures 9a, b, 10a, b)

"Serpula subrotunda dorso elevato" Walker and Boys, 1784, Test. Min., p. 2, pl. 1, fig. 4.

Vermiculum subrotundum Montagu, 1803, Test. Brit., pt. 2, p. 521.

This species occurs in all facies except facies 1. It is most abundant in facies 3A where it forms as much as 10 per cent of the fauna. Its occurrence in facies 2 is very slight and follows the same pattern as that of the other attached forms. Cushman, (1944, p. 15) refers to this species as *Quinqueloculina disciformis* (Macgillivray) and points out that in this area it is commonly found attached to algae and hydroids.

REOPHAX CURTUS Cushman

(Plate 1, figure 18)

Reophax curtus Cushman, 1920, Bull. 104, U. S. Nat. Mus., pt. 2, p. 8, pl. 2, figs. 2, 3.

R. curtus is confined to facies 3. It is found on the adjacent continental shelf but no depth limits of occurrence are reported.

REOPHAX DENTALINIFORMIS H. B. Brady

(Plate 1, figure 19)

Reophax dentaliniformis H. B. Brady, 1881, Quart. Jour. Micr. Sci., vol. 21, p. 49; 1884, Rept. Voy. CHALLENGER, Zool., vol. 9, p. 293, pl. 30, figs. 21, 22.

This form is found in facies 2 at low percentages. This does not agree with the distribution of the species in other localities where it is reported to depths of 4300 m. A possible explanation of this may be that in facies 2 the species is almost entirely confined to sediments containing mud, and mud bottoms are relatively infrequent in facies 3.

REOPHAX NANA Rhumbler

(Plate 1, figures 14, 15)

Reophax nana Rhumbler, 1913, Ergeb. Plankton-Exped. Humboldt Stiftung, bd. 3, pt. 2, p. 471, pl. 8, figs. 6–12.

Reophax sp. ?, Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 10, pl. 1, fig. 20.

R. nana is most common in facies 2 in Buzzards Bay, where it composes as much as 9 per cent of the fauna. It occurs very rarely in facies 2 in Long Island Sound, mostly in Gardiners Bay, and in facies 3 in the vicinity of Cuttyhunk.

ROTALIA BECCARII (Linné) and variants

(Plate 5, figures 5a, b, 7a, b, 8a, b)

Nautilus beccarii Linné, 1758, Syst. Nat., ed. 10, p. 710.

This species occurs in facies 2 and 3. Although it is found along the Connecticut shore it occurs only at a few stations in the eastern part of central Long Island Sound. It is most abundant in facies 3A and in Buzzards Bay (facies 2) reaching maximum frequencies of 33 per cent. The relative abundance decreases in the well-developed portion of facies 3 and the occurrence is less persistent. A variant similar to *R. beccarii* var. *tepida* Cushman is found in facies 2 and at one station in facies 3A. Another variant referable to *R. beccarii* var. *sobrina* Shupack is found more persistently in facies 2 and at 3 stations in facies 3A.

The frequency of *R. beccarii* fluctuates greatly from station to station. These fluctuations cannot be definitely traced to sedimentary changes. In some areas the frequency falls in muddy sediments adjacent to sand but in others the mud samples contain a high percentage of the species.

TEXTULARIA cf. TENUISSIMA Earland[1]

(Plate 2, figures 4, 5)

Textularia tenuissima Earland, 1933, Discovery Repts., vol. 7, p. 95, pl. 3, figs. 21–30.

Textularia elegans Lacroix, 1932 (not *Plecanium elegans* Hantken), Bull. Instit. Ocean. Monaco, no. 591, p. 8, text. figs. 4, 6.

This form is tentatively referred to Earland's although it differs to some extent. At some stations in Gardiners Bay it is very irregular in form and has a much greater thickness (0.1 mm. or more). The wall of all the specimens is less smoothly finished than indicated by Earland and is colored by ferruginous material. In this respect it more closely resembles Lacroix's species from the Mediterranean which is included by Earland with his species from South Georgia.

The species occurs most commonly in Buzzards Bay but is present at occasional localities in facies 2 and 3 throughout the rest of the area. It never forms more than 2 per cent of the fauna and usually much less.

TRILOCULINA BREVIDENTATA Cushman

(Plate 2, figures 11a, b)

Triloculina brevidentata Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 16, pl. 2, fig. 25.

This species occurs in facies 2 in Gardiners Bay and Buzzards Bay. The specimens are smaller than those described by Cushman, being usually less than 1 mm. in length. In other respects they are identical with his type specimens.

TROCHAMMINA COMPACTA n.sp.

(Plate 2, figures 13a, b, 14a, b, 15a, b)

Trochammina conica Cushman (not Earland), 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 18, pl. 2, fig. 9.

Test small, concavo-convex, often with a high, trochoid spire which is broad and not pointed, composed of 3–4 whorls, thickness of test

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[1] *T. tenuissima* Earland is preoccupied by *T. tenuissima* Häusler 1881. The new name *Textularia earlandi* is proposed for Earland's species.

2/5 to 4/5 of diameter, ventral side concave, sometimes with a deep umbilicus; periphery rounded, narrow, slightly lobulate; chambers 3-4 in the adult whorl but most commonly 3, slightly inflated on the ventral side, less so on the dorsal side; spiral suture usually distinct, others often obscure, straight in early chambers, oblique, slightly curved, in adult chambers; wall slightly rough, composed of medium-sized sand grains; aperture a narrow arched opening at the base of the chamber. Maximum diameter 0.26 mm.

Holotype from sta. 199 in Buzzards Bay at a depth of 12 m., Lat. 41° 36.5′ N, Long. 70° 45.1′ W.

This species differs from *T. conica* Earland in the less inflated chambers, which in the latter species are almost globular and inflated on both sides of the test, in the almost non-lobulate periphery, and the more compressed test. It occurs in facies 2 and 3. In Long Island Sound the occurrence is confined to the central portion and Gardiners Bay. The most abundant and consistent occurrence is in Buzzards Bay where it forms a maximum of 10 per cent of the fauna.

TROCHAMMINA INFLATA (Montagu)

(Plate 3, figures 1a, b)

Nautilus inflatus Montagu, 1808, Test. Brit., Suppl., p. 81, pl. 18, fig. 3.

This species has a very scattered distribution. It is found in facies 1 at 3 stations in the Connecticut and Housatonic Rivers; in facies 2 at sta. 36 off the Connecticut shore, and sta. 205 and 206 at the head of Buzzards Bay; in facies 3A at sta. 160 and 161 northwest of Cuttyhunk. In all cases the species forms a very low percentage of the fauna. Phleger and Walton (1950, p. 280) found *T. inflata* in great abundance in Barnstable marsh. In the adjacent traverses in Cape Cod Bay the occurrence was very sparse and entirely in the traverse opposite the harbor outlet. These specimens were probably washed out of the marsh by tidal currents. In all cases the specimens found outside of facies 1 in the Long Island Sound-Buzzards Bay area are at nearshore stations and probably were also washed from neighboring marshes. Reported occurrences in the literature do not contradict the hypothesis that this is a marsh species.

TROCHAMMINA LOBATA Cushman

(Plate 3, figures 2a, b)

Trochammina lobata Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 18, pl. 2, fig. 10.

This is a widely distributed species in facies 2 and 3 (one exception). The highest frequencies are in facies 3 and at occasional stations in facies 2 in Buzzards Bay, with a maximum of 8 per cent. It is found at depths of less than 90 m. on the adjacent continental shelf (Parker, 1948, p. 221).

TROCHAMMINA MACRESCENS H. B. Brady

(Plate 3, figures 3a, b)

Trochammina inflata (Montagu) var. *macrescens* H. B. Brady, 1870, Ann. Mag. Nat. Hist., ser. 4, vol. 6, p. 51, pl. 11, figs. 5a-c.

T. macrescens has a similar distribution to *T. inflata* although it is more abundant in the Connecticut River, reaching a frequency of 16 per cent. It is found at three stations outside of facies 1: sta. 79, 160, 205. These occurrences have very low frequencies and it is probable that the specimens were washed from neighboring marshes as in the case of *T. inflata.* This species resembles *Jadammina polystoma* Bartenstein and Brand, but has a typical *Trochammina* aperture.

TROCHAMMINA SQUAMATA Parker and Jones, and related species

(Plate 3, figures 4a, b, 5a, b)

Trochammina squamata Parker and Jones, 1865, Phil. Trans. Roy. Soc. London, vol. 155, p. 407, pl. 15, figs. 30, 31a-c.

Trochammina propria Cushman, 1944, Spec. Publ. 12, Cushman Lab. Foram. Res., p. 19, pl. 2, fig. 11.

Representatives of this group are found in small quantities in all facies. It is probable that there are several species and/or variants, but in view of their scarcity it has not seemed feasible to subdivide them. The two most important representatives of the group are *T. squamata* as originally figured by Parker and Jones, which is apparently identical to Cushman's *T. propria*, and *T. ochracea* (Williamson).

URNULINA COMPRESSA Cushman

(Plate 1, figure 9)

Urnulina compressa Cushman, 1930, Bull. 4, Florida State Geol. Surv., p. 15, pl. 1, figs. 2a, b.

This species occurs at frequencies as great as 13 per cent in facies 1 in the Connecticut River, but occurs at only one station in the

Housatonic River. A single specimen is reported from the mouth of the Merrimack River (Parker, 1952 p. 394) north of Cape Cod. The species is variably spinose at the base, although not originally so described.

URNULINA DIFFLUGAEFORMIS Gruber

(Plate 1, figure 10)

Urnulina difflugaeformis Gruber, 1884, Nova. Acta k. Leop.-Carol. Deutsch. Ak. Nat., vol. 46, p. 496, pl. 8, fig. 18.

This species occurs at low frequencies in facies 1 in the Connecticut River.

VIRGULINA FUSIFORMIS (Williamson)

(Plate 4, figure 6)

Bulimina pupoides d'Orbigny var. *fusiformis* Williamson, 1858, Rec. Foram. Great Britain, p. 63, pl. 5, figs. 129, 130.

This species occurs at very low frequencies throughout facies 3 and at occasional stations in facies 2 in Buzzards Bay. It occurs in all facies on the continental shelf and adjacent slope (Parker, 1948, p. 240).

CONCLUSIONS

1. There are three Foraminiferal facies in the Long Island Sound-Buzzards Bay area: 1) river facies, 2) bay facies, 3) shallow-water, open-ocean facies.
2. There is evidence that the Foraminifera of the river facies are mixed with those of marsh facies washed in by tidal currents. Mixing also occurs at other facies boundaries.
3. Temperature appears to be an important controlling factor in the change from bay to open-ocean Foraminifera facies. Salinity appears to be an important controlling factor in the change from river to bay Foraminifera facies. It is probably less important in the change from bay to open-ocean Foraminifera facies.
4. Attached forms are best developed on sandy and stony bottoms. There is little indication of sedimentary control of other species.

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Contribution No. 10, Marine Foraminifera Laboratory.
Contribution No. 590, Woods Hole Oceanographic Institution.

Table 1

Locations of stations giving depth and type of sediment.

Station No.	*N. Latitude*	*W. Longitude*	*Depth in Meters*	*Type of Sediment*
1	41°23.6′	72°25.0′	6	sand
2	41°23.3′	72°24.4′	5	sand
3	41°23.3′	72°23.8′	7.5	sand
4	41°23.1′	72°23.3′	3	sand
5	41°22.8′	72°22.7′	11.5	sand
6	41°22.3′	72°22.5′	4.5	sand
7	41°21.8′	72°22.7′	7	sand
8	41°21.3′	72°22.7′	3	sand
9	41°21.1′	72°23.1′	—	silt
10	41°20.8′	72°22.7′	4.5	sand
11	41°20.3′	72°21.6′	8	sand
12	41°19.9′	72°21.2′	2.5	sand
13	41°19.8′	72°20.8′	3	sand
14	41°19.4′	72°20.7′	5	silt
15	41°18.9′	72°20.8′	5	silt
16	41°18.4′	72°21.0′	5.5	sand
17	41°17.9′	72°20.9′	4	sand
18	41°17.4′	72°20.9′	3.5	sand
19	41°16.9′	72°20.7′	5	sand
20	41°16.5′	72°20.5′	12	sand
21	41°15.9′	72°19.6′	2	sand
22	41°15.8′	72°18.9′	4	sand
23	41°15.6′	72°18.3′	4	sand
24	41°15.4′	72°21.8′	6.5	sand and mud
25	41°15.0′	72°22.8′	10	sand
26	41°14.9′	72°24.3′	15	sand and mud
27	41°14.7′	72°25.6′	17	sand
28	41°14.7′	72°27.0′	20	sand
29	41°14.5′	72°28.2′	20	sand
30	41°14.3′	72°29.5′	10	sand
31	41°14.1′	72°32.2′	10	sand
32	41°14.0′	72°33.3′	15	sand and mud
33	41°13.8′	72°34.7′	15	—
34	41°13.7′	72°36.1′	15	sand
35	41°13.6′	72°37.4′	14	fine sand
36	41°13.5′	72°38.7′	14	sand
37	41°13.4′	72°40.0′	12	fine sand
38	41°13.4′	72°41.3′	12	sand
39	41°13.3′	72°42.6′	10	sand and stones
40	41°13.3′	72°43.9′	12	fine sand
41	41°13.3′	72°45.2′	12	mud
42	41°13.3′	72°46.6′	11	sand and mud

Station No.	*N. Latitude*	*W. Longitude*	*Depth in Meters*	*Type of Sediment*
43	41°13.3′	72°47.8′	9	sand and mud
44	41°13.1′	72°49.2′	10.5	sand and mud
45	41°12.8′	72°50.5′	12	sand and mud
46	41°12.5′	72°51.8′	—	—
47	41°12.3′	72°53.1′	14	sand and mud
48	41°12.0′	72°54.4′	10.5	sand and mud
49	41°11.7′	72°55.8′	11	sand
50	41°11.4′	72°57.1′	12	sand
51	41°11.1′	72°58.4′	12	sand and mud
52	41°10.9′	72°59.8′	11	mud
53	41°10.6′	73°01.1′	9	sand and mud
54	41°10.3′	73°02.4′	9	sand and mud
55	41°10.0′	73°03.8′	9	sand and mud
56	41°09.7′	73°05.0′	7	sand and mud
57	41°09.8′	73°06.1′	3	sand and stones
58	41°10.1′	73°06.5′	2	—
59	41°10.9′	73°07.3′	3	silt
60	41°11.3′	73°07.2′	5	sand
61	41°11.7′	73°06.7′	4	sand
62	41°12.3′	73°06.6′	4	sand
63	41°12.7′	73°06.6′	4	sand
64	41°13.3′	73°06.5′	2	sand
65	41°09.1′	73°05.6′	6.5	black mud
66	41°08.1′	73°05.7′	10	black mud
67	41°07.1′	73°05.8′	13	black mud
68	41°06.0′	73°05.9′	13	sand and mud
69	41°05.0′	73°05.9′	18.5	sand and mud
70	41°04.0′	73°05.8′	7	stony
71	41°03.7′	73°05.4′	15	sand
72	41°03.9′	73°04.1′	22.2	sand and mud
73	41°04.1′	73°02.8′	27	mud
74	41°04.4′	73°01.5′	28.5	mud
75	41°04.5′	73°00.2′	27.5	mud
76	41°04.8′	72°58.8′	27.5	sand and mud
77	41°04.9′	72°57.5′	24	sand and mud
78	41°05.2′	72°56.2′	29	mud
79	41°05.4′	72°54.9′	29	mud
80	41°05.6′	72°53.6′	29	mud
81	41°05.8′	72°52.2′	27.5	sand and mud
82	41°05.9′	72°50.9′	28	mud
83	41°06.1′	72°49.5′	28	mud
84	41°06.3′	72°48.3′	28	sand and mud
85	41°06.4′	72°46.9′	29	silt
86	41°06.6′	72°45.6′	28.5	fine sand
87	41°06.7′	72°44.2′	28.5	sand and mud

Station No.	*N. Latitude*	*W. Longitude*	*Depth in Meters*	*Type of Sediment*
88	41°06.8′	72°42.9′	27.5	sand and mud
89	41°07.0′	72°41.5′	28	sand and mud
90	41°07.2′	72°40.2′	27	fine sand
91	41°07.3′	72°38.8′	27	sand and mud
92	41°07.5′	72°37.5′	26	—
93	41°07.7′	72°36.1′	24	sand
94	41°07.8′	72°34.9′	21	sand
95	41°07.9′	72°33.5′	21.5	sand
96	41°08.1′	72°32.1′	26	sand
97	41°08.3′	72°30.8′	27	sand
98	41°09.3′	72°30.4′	20	sand
99	41°09.5′	72°13.4′	8	sand
100	41°08.4′	72°13.6′	8	sand and mud
101	41°07.3′	72°13.7′	11	sand and mud
102	41°06.4′	72°13.8′	10.5	sand and mud
103	41°05.3′	72°13.9′	10.5	mud
104	41°04.3′	72°14.0′	8	sand and mud
105	41°03.4′	72°14.1′	5	sand
106	41°03.8′	72°12.7′	11	sand and mud
107	41°04.2′	72°11.5′	9	sand and mud
108	41°04.6′	72°10.3′	4.5	sand
109	41°05.6′	72°10.0′	10	sand and mud
110	41°06.6′	72°09.7′	9	silt
111	41°07.6′	72°09.3′	13	fine sand
112	41°08.6′	72°08.9′	25	sand
113	41°09.6′	72°08.4′	28	sand and mud
114	41°10.5′	72°07.9′	7.5	sand
115	41°11.5′	72°07.6′	7	sand, stones
116	41°17.8′	72°04.4′	11	mud
117	41°16.9′	72°04.0′	15	mud
118	41°16.0′	72°03.5′	20	mud
119	41°15.2′	72°04.4′	37	mud
120	41°15.1′	72°05.0′	61	mud
121	41°15.0′	72°06.1′	61	sand
122	41°14.8′	72°06.9′	61	sand
123	41°14.6′	72°08.2′	67	sand
124	41°14.4′	72°06.1′	76	sand
125	41°14.1′	72°03.8′	61	sand
126	41°15.4′	71°59.3′	12	sand
127	41°15.7′	71°58.8′	9	sand
128	41°15.9′	71°58.1′	15	sand
129	41°16.1′	71°57.4′	15	sand
130	41°16.3′	71°56.8′	14	sand
131	41°16.5′	71°56.1′	14	sand
132	41°16.7′	71°55.5′	12	sand

Station No.	*N. Latitude*	*W. Longitude*	*Depth in Meters*	*Type of Sediment*
133	41°16.5′	71°54.6′	24	stony
134	41°16.6′	71°53.5′	37	sand
135	41°16.5′	71°52.3′	40	sand
136	41°16.6′	71°50.5′	40	sand
137	41°16.6′	71°49.0′	42	mud
138	41°16.7′	71°47.5′	42	mud
139	41°16.7′	71°46.0′	36	mud
140	41°16.7′	71°44.5′	36	sand
141	41°16.7′	71°43.1′	37	mud
142	41°16.8′	71°41.6′	37	mud
143	41°16.8′	71°40.1′	38	mud
144	41°16.8′	71°38.7′	37	mud
145	41°16.9′	71°37.2′	38	sand
146	41°16.9′	71°34.3′	41	sand
147	41°17.0′	71°32.6′	43	mud
148	41°15.8′	71°32.2′	43	sand
149	41°14.8′	71°31.9′	24	sand
150	41°13.8′	71°31.6′	38	sand
151	41°11.8′	71°32.5′	21	stony
152	41°15.8′	71°55.4′	46	stony
153	41°15.4′	71°54.9′	49	sand
154	41°14.8′	71°54.1′	41	sand
155	41°14.1′	71°54.3′	43	sand
156	41°13.3′	71°54.4′	40	sand
157	41°12.3′	71°55.5′	30	sand
158	41°11.5′	71°56.1′	55	sand
159	41°10.6′	71°57.0′	21	sand
160	41°26.7′	71°07.8′	20	sand and stones
161	41°27.0′	71°05.2′	11	sand and stones
162	41°27.3′	71°02.6′	14	sand and stones
163	41°27.5′	71°01.2′	17	sand and stones
164	41°27.3′	71°00.6′	17	sand
165	41°27.6′	70°59.4′	24	sand
166	41°27.9′	70°58.2′	29	sand
167	41°28.3′	70°56.9′	27	sand
168	41°26.9′	71°00.3′	18	sand
169	41°25.8′	71°02.4′	18	sand
170	41°24.6′	71°04.4′	20	sand
171	41°24.3′	71°05.7′	21	sand
172	41°23.7′	71°06.8′	22	sand
173	41°23.1′	71°07.9′	24	sand
174	41°22.4′	71°08.9′	27	sand
175	41°21.7′	71°10.1′	28	sand
176	41°27.0′	70°59.4′	18	mud, sand, stones
177	41°26.4′	70°59.5′	27	sand and mud

Station No.	*N. Latitude*	*W. Longitude*	*Depth in Meters*	*Type of Sediment*
178	41°25.6′	70°59.7′	34	mud
179	41°24.7′	70°59.9′	33	mud
180	41°23.8′	71°00.1′	33	mud
181	41°22.8′	71°00.3′	30	mud
182	41°21.8′	71°00.1′	28	mud
183	41°20.8′	71°00.2′	28	sand
184	41°19.8′	71°00.3′	27	sand
185	41°18.8′	71°00.9′	33	sand
186	41°17.9′	71°01.5′	37	mud
187	41°32.9′	70°45.2′	15	sand and mud
188	41°33.4′	70°46.4′	15	mud
189	41°33.8′	70°47.6′	15	mud
190	41°34.2′	70°48.8′	9.5	sand
191	41°34.2′	70°46.9′	14.5	sand and mud
192	41°34.3′	70°45.5′	12.5	sand
193	41°34.4′	70°44.1′	13	sand and mud
194	41°34.4′	70°42.9′	13	sand and mud
195	41°34.5′	70°41.5′	13	sand
196	41°34.5′	70°40.3′	4.5	sand and stones
197	41°35.1′	70°41.4′	16	mud
198	41°36.2′	70°44.0′	12.5	sand and mud
199	41°36.5′	70°45.1′	12	sand and mud
200	41°37.0′	70°46.3′	12	sand and mud
201	41°37.7′	70°45.4′	13	mud
202	41°38.4′	70°44.4′	9.5	sand and mud
203	41°39.0′	70°43.5′	9	sand and mud
204	41°39.6′	70°42.5′	7	sand and mud
205	41°40.4′	70°41.7′	8	sand and mud
206	41°41.0′	70°40.8′	8	sand

STATION NO.	5	7	8	9	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	29	30	31	32	34	35	36	37	39	40	41	43
Ammoastuta salsa						10		1				.7				.5				.3		.2									
Ammobaculites cf. exiguus						4		1			13																				
Ammoscalaria fluvialis						2						.7			1																
Bolivina variabilis																.9						.2				.2					
Cibicides lobatulus																						.2									
Discorbis columbiensis																.5	.3	1						.6		.2					
Eggerella advena						.9	5	13				1	6		1	4	.6	2		5	1	.5	.5		.9	1	3	.2	2	1	.9
Elphidium advenum																					.2										
E. advenum var. margaritaceum												.7					.3														
E. excavatum																			.7	.5	.2			.6			.1		.2		
E. incertum & variants								3				10	75	36	81	54	89	81	88	65	86	85	72	91	79	75	86	68	75	85	90
E. subarcticum																2	2	5	1	9	3	3	6	2	5	4	2	6	2	2	2
Eponides frigidus var calidus												2			3	3	3	4	5	14	8	9	19	2	13	17	11	22	21	11	7
E. wrightii																									.3						
Hopkinsina pacifica atlantica																												2			
Lagunculina vadescens		1														.5															
Leptodermella variabilis		21	30	6		8	16	1				7			1	3															
Miliammina fusca				11				9	40	33	37	3	6	9	1	4								1		.2			2		
Nonion tisburyensis												3	6	9	3	9		3	.7	.5	2		■	6	6	.■	3	2	.3	7	
Poroeponides lateralis																.5		3													
Proteonina hancocki		20	10	5		12	5	12				7			3	2															
P. lagenarium	100	40	20	60	100	21	42	40	40	33	13	31			3	16	6			.8	2	2	5		3	2			3		
P. sp. B.		7	10	1		.9						3																			
Pseudopolymorphina novangliae																				.3								.2			
Quinqueloculina seminula																	1	3	2									2			
Q. seminula var jugosa																	.9	7	.7		2										
Q. subrotunda																.5	1	2	1		2							.5			
Rotalia beccarii																		3		3		5	3	6	3		6				
R. beccarii var. tepida																							.3								.2
Textularia cf. tenuissima								1													2										
Trochammina inflata								1																		.2					
T. lobata															1			.3						.6	.3						
T. macrescens						4	16	1				10																			
T. squamata		1	20	5		3	5	10	20	33	13	5		46	1	2		2		4		1	3		6	.3	3	.7	2		
Urnulina compressa		10	10	8		7	11	6			13	11	6		1	4															
U. difflugaeformis				4		4					13	3				2															
TOTAL POPULATION	2	85	10	80	2	110	20	80	5	■	■	150	16	11	80	210	650	750	150	750	1000	13300	3000	2600	10800	5000	22000	425	10700	3300	3800

Table 2. Percentage distribution of Foraminifera at sta. 5–43.

STATION NO.	45	47	48	50	52	53	55	56	57	58	59	60	61	62	63	64	65	66	68	70	71	72	73	75	76	78	80	82	84	85	86	88
Ammoastuta salsa			.1																													
Ammobaculites cf. exiguus											18																					
Ammoscalaria fluvialis											75						.1															
Bolivina variabilis						.1																										
Discorbis columbiensis																							.1								.2	
Eggerella advena	4	.4	1	.9	1	5	1	1										.3	.3	.9	7	7	21	7	6	9	12	15	27	9	17	19
Elphidium advenum													5																			
E. advenum var. margaritaceum																					.2											
E. excavatum	.1																												.4			
E. incertum & variants	81	76	79	86	85	75	84	88	85	32	2	50	37	50	41	33	98	96	94	86	56	46	37	66	66	57	41	43	39	55	45	50
E. subarcticum	3	3	4	3	2	3	2	.4	3		.6		32		14		.3	.2	.8	5	13	5	4	3	6	10	5	10	5	4	2	5
Eponides frigidus var calidus	16	20	15	10	11	17	12	9	9	33			21		45	33	1	3	4	9	23	41	35	22	21	21	41	29	24	28	29	25
E. wrightii																				.3												
Hopkinsina pacifica atlantica																											.4				.4	
Leptodermella variabilis														50																		
Miliammina fusca									1		6																					
Nonion tisburyensis	.5	4			.2																											
Proteonina atlantica																						.1					.4					2
P. hancocki												50																				
P. sp. A																												5	.2	.4	.2	
Pseudopolymorphina novangliae																										2						
Quinqueloculina seminula																					2											
Reophax dentaliniformis				1		3	.2											3				.2	3	.6	2	.8			2	.2	1	
R. nana				1																									.2			
Rotalia beccarii					1			2																								
R. beccarii var. tepida	1	1																														
Textularia cf. tenuissima				1				2															1						4		2	
Trochammina compacta																														4	2	
T. inflata										33						33																
T. lobata				1																	.5											
T. macrescens											2																					
T. squamata	1	1	1			1		4			2		5					.3			2	.3	1	3	2	2	4	3	3	3	4	1
Urnulina compressa											.6																					
TOTAL POPULATION	4300	5400	13000	43000	14100	5500	14000	1500	69	3	270	2	19	2	22	3	50000+	50000+	2700	1300	2200	1800	700	2800	1000	475	1000	1500	2000	3800	1900	800

Table 3. Percentage distribution of Foraminifera at sta. 45–88.

STATION NO.	89	90	92	93	94	95	97	99	100	102	103	105	106	108	110	112	113	114	116	117	118	119	121	122	123	125	127	129	130	131	132	134
Ammoastuta salsa																			4													
Ammobaculites cf. exiguus																					3											
A. cf. foliaceus																				1	1	4										
Ammoscalaria fluvialis																					7											
Bolivina pseudoplicata			2														8						6	3		1		6	5	3		1
B variabilis												2	2	.2			.3	.3							6	6	1	6			8	6
Bulimina aff aculeata																				2				3				3	5	3	4	3
Cibicides concentricus																														3	2	
C lobatulus	3		3	3	3	10										1	1	2	4	.8		2	5	4	3	3	1	4	8	6	9	8
Discorbis columbiensis		2	9	1	1		19	2		1				2		3	7	28		6		1	9	10	9	12	28	24	8	9	9	11
D squamata																								7		2	1	3			2	7
Eggerella advena	19	10	6	7	15	10	4	6	4	3	4	7	2	2	4	4	14	5	13	6	7	5	5	2	2	7	15	3	4	1	5	6
Elphidium advenum								7				2		4		1	1	3					6			6	1	2	1	1	2	.7
E advenum var. margaritaceum		4	5	2	1					.1		3	1	6		3	6	1		8	.3		6	3			1	1	5	3	1	1
E excavatum				5										.6	.5	.8																
E incertum & variants	47	61	67	47	39	40	15	32	70	77	70	33	70	30	70	40	32	14	65	60	58	48	17	10	18	11	6	16	22	13	22	24
E subarcticum	2	5	16	24	23	20	23	45	3	4	10	34	11	38	6	32	31	19	4	11	8	18	24	13	7	1.1	4	18	15	27	15	23
Eponides frigidus																	6							.5		6		2	1	3	8	4
E frigidus var calidus	27	20	8	5	11		4	8	18	13	14	7	8	5	11	7	2	1	2	5	3	6	4	8	.2	6		1	4	2	3	3
E wrightii							.2	3				2		10		3	9	7	4					.5	.6		12	1	5	5	6	3
Globulina caribaea			2	5			2																6	.3					5	1		
Glomospira gordialis																								3		5	1					
Hopkinsina pacifica atlantica		.2		.2					.6		1				.5		.3															
Miliammina fusca																	.3				.3			.3								
Nonion tisburyensis		.2							.9	2	2	1	.5							1	1	3										
Nonionella atlantica																						4	6	5	6					3		3
Pninaella pulchella																										6	1	.9				
Poroeponides lateralis				5			4									4	9	4				4	11	22	18	17	6	6	5	10	3	2
Proteonina atlantica	.9	5	.8	3				.2											.4	.4	1	2								1	1	1
P. sp. A	.3																															
Pseudopolymorphina novangliae									1	1	1	2		8					4	2	1	8			6					7		3
Pyrgo striatella																						8		3	6	1		.6	1	1	2	2
Quinqueloculina seminula												.5		2																		
Q. seminula var. jugosa							.2	.2				.9											1	2	.6			.3				
Q. subrotunda				2	3	5	2					.2				2	6	15					10	9	9	3	4	2	5		2	2
Reophax dentaliniformis									.6	8	5																					
R. nana									4		4		.1		5																	
Rotalia beccarii			.8	4	3	15		4	8	6		9	4	2	.9	2	4	2	11	10	16	11	7	15	21	9		7	6	17	9	3
R. beccarii var. sobrina								4	6			5		8																		
R beccarii var tepida											3	2	.1																			
Textularia cf tenuissima	3	2						7					1																			
Triloculina brevidentata								2				5		6																		
Trochammina compacta	.3	2	.2								.1	.2	.2						.4										5	3	8	3
T lobata	.9		.6	1	1			2				5	1	2		4	.6	3	1	1	1	2		3				3	2		6	
T squamata	2	1	1	7			23	2	1	.4	5	2	1		8		.5	3	7	[illegible]	1		2	3	2	11	6	4	5	.3	2	1
Virgulina fusiformis																						.4	.6		6	6		.9	.5			1
TOTAL POPULATION	5100	2200	650	400	80	20	48	900	50000	50000	12400	6800	3700	2000	1700	525	350	2300														

Table 4. Percentage distribution of Foraminifera at sta. 89–134.

STATION NO.	135	136	138	140	142	143	145	146	147	148	150	151	152	153	155	157	158	159	160	162	163	165	166	168	169	171	172	174	175	177	179	181	182	183	184	185	186
Ammobaculites foliaceus	2	9	4	2	2	5	1			5			2	2												1	3	9	3				8		.3		
Bolivina pseudoplicata	1					.5	3		.3	3	7		.6		4					1			2	9				3	3		8	.8	1	1	.3		
B variabilis																															2	2					
Bulimina aff aculeata						5	3						6										■				3	.3					5				
Cibicides concentricus																					4				2	7				1	2						
C lobatulus	1	9					1			3	2	8	1	5	2	6				2	2		1	2	3	1			3	2	2	6	1		3	5	
Discorbis columbiensis							1	3		3	7	8	6		2	1	2			22	3	1	2	5	3	2			3	6	5	2	2		3		
D. squamata																								.2												2	
Eggerella advena	15	13	28	18	44	45	3	37	39	33	34	2	5	21	13	6	6	3	15	12	1	7	6	7	9	11	40	37	11	6	11	15	11	9	23	5	13
Elphidium advenum																				1	.9		.2			3					2	2	3				
E. advenum var margaritaceum								1		5	9									3			4	9		3				7	8	6			3		
E excavatum																							4			2	3									2	
E incertum & variants	31	36	25	31	19	16	24	23	20	16	4	6	42	46	58	66	66	54	40	27	26	78	67	44	26	45	14	30	19	38	55	58	50	56	50	27	19
E subarcticum	11	8	4		2	9	14	4	9	8	5	2	21	6	11	11	10	8	3	1	18	3	10	17	29	7	6	6	3	10	8	5	4	9	2	2	2
Eponides frigidus	7	7	8	9	3	3	4	5	5	7	2	4	2	5	3	3										1		1			2	8	3		1		
E frigidus var. calidus		2	1		1	1	7	1	3	1			1	3	3	2					2	3	2	2	3	1		1		1	1	2	2		1		
E wrightii									3			6								1	4		2	2								2					
Globulina caribaea																2													3							2	
Glomospira gordialis																								7			3									2	
Labrospira crassimargo			3	7	4	5	2	2	2																												2
Miliammina fusca																										3											
Nonionella atlantica														5	4	6																		1			
Poroeponides lateralis											2	25			4					13	3			2	2					2	2					2	
Proteonina atlantica	19	25	17	33	17	24	40	17	26	31	25	2	13	9	4	2	6		10		4	.5	2			5	17	21	39	1	2	5	14	5	12	39	61
Pseudopolymorphina novangliae							.7							5						5				4		3	7	3	6			4	3	1			
Pyrgo striatella							1				2	2				6					.4					7	3			7	4		3				
Quinqueloculina seminula	1	2					2	6	3			15	6				7		5	3	3		4		2		3			3				2	3	2	
Q seminula var jugosa		.9					3		3									5		.5	3			2		1											
Q. subrotunda								6				2						5	3	5						.3	7						3				
Reophax curtus		2	2	3	4	3	2	4	4	7	3		6															6				.2	5		.8		2
R nana																			3							3	.3					2					
Rotalia beccarii	2	2	4	7	1	5	1				2		1	4	8	.6		18	10	5	33	5	10	16	18	16	13	2	6	25	13	7	■	9	2		
R. beccarii var sobrina																							.2	2													
Textularia tenuissima			9		5			.3																.2													
Trochammina compacta	1		2	.7	1									.5										.2		7	1					2					
T inflata																			5	2																	
T. lobata	1	3	.9	3	3	2	.7	.9	9	.5	4	2	7	1	2		2	3	3		1		.2		5	1	1	5	3		.6	2	1	4	6		
T macrescens																			3																		
T squamata	2		3			.9		.6	2	2			.6	.5	.8	3		5	3	1		.5		3			1	1					.5		.3	2	
Virgulina fusiformis	1					.5		.3		.3						.6						.5		.■							.2				.■		.6

Table 5. Percentage distribution of Foraminifera at sta. 135–186.

STATION NO.	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206
Ammobaculites cf. dilitatus					.2						.1	.2		8	.8					
Bolivina pseudoplicata										.4						.4		.2		
B. variabilis				.2				.3												
Cibicides lobatulus				.6															1	.1
Discorbis columbiensis				.3				.2		.2						2	4	1	2	14
Eggerella advena	10	17	12	13	57	41	76	27	7	.4	29	74	66	49	10	11	2	2	7	6
Elphidium advenum				7				.2	6	24	.1					.7	1	5	5	1
E. advenum var. margaritaceum				3				.2		11							.7	.7	.5	7
E. excavatum				.4		.1		.6							.8	15	11	8	2	
E. incertum & variants	61	61	77	12	13	13	4	32	35	2	44	5	5	12	61	30	31	24	41	22
E. selseyense				1						11						2	.4	.7		1
E. subarcticum	20	16	6	16	13	19	13	25	16	2	4	6	6	20	13	13	5	5	23	11
Eponides frigidus var. calidus	2	2	2	2	2	1	1	2	7	1	2	.7	.8	2	4	3	3	6	4	8
E. wrightii				6						.7							.7			
Hopkinsina pacifica atlantica						.2		2								.9			.3	
Miliammina fusca											.1			.2	.1				.1	
Nonion tisburyensis								.4	.3		.3				4				.6	.9
Poroeponides lateralis				.6																
Proteonina sp. A			.9		.2	.1	.3	.2			2	5		3	1			.2	.3	
Pseudopolymorphina novangliae				.4		.9			2	1		.2		.2	.1	.4	1	1	.4	
Quinqueloculina seminula	.1			5		.2		.3	1	3							4	4		
Q. seminula var. jugosa				.6						.4								.7		
Reophax dentaliniformis											.2				.3	.2				
R. nana		.3	2		6	.6	.5	3			4	9	4	9	3	.4	4	1	2	
Rotalia beccarii				19	3	6		2	19	7	5		3	.3	.4	16	30	29	4	·3
R. beccarii var. sobrina						.1	.3			1	3	.2	4			3				2
R. beccarii var. tepida					.2	.7		.7	1							3	2	1	.9	
Textularia tenuissima				.4	1		.3	.4	.3		1	.2		1	.1	.2			2	2
Triloculina brevidentata				6		6			.9	30						.2	2	4	4	2
Trochammina compacta	.7	2		.2	6	6	2	1	3		9	3	10	2		.2	2	2	3	1
T. inflata																			.6	2
T. lobata				2	.6	6	2	.9	8		.2	.2	5				7	.9	.6	4
T. macrescens																			.3	
T. squamata	1							.4			1	2	.2	3					2	3
Virgulina fusiformis								.2							.2	.2			.1	
TOTAL POPULATION	3000	600	850	450	1000	800	725	2500	625	275	16000	425	525	500	2900	3700	1100	1700	1600	100

Table 6. Percentage distribution of Foraminifera at sta. 187–206.

PLATE 1

Fig. 1, 2. *Proteonina atlantica* Cushman. X 50. (1) Sta. 145; (2) Sta. 93.

Fig 3. *Proteonina hancocki* Cushman and McCulloch. X 70. Sta. 9.

Figs. 4, 5. *Proteonina lagenarium* (Berthelin). X 70. Sta. 24.

Fig. 6. *Proteonina* sp. *A*. X 70. Sta. 200.

Fig. 7. *Proteonina* sp. *B*. X 70. Sta. 9.

Fig. 8. *Lagunculina vadescens* Cushman and Bronnimann. X 70. Sta. 24.

Fig. 9. *Urnulina compressa* Cushman. X 70. Sta. 20.

Fig. 10. *Urnulina difflugaeformis* Gruber. X 70. Sta. 9.

Figs. 11a, b, 12. *Leptodermella variabilis* n.sp. X 70. (11) Holotype; (12) Paratype. Sta. 24.

Fig. 13. *Glomospira gordialis* (Jones and Parker). X 50. Sta. 168.

Figs. 14, 15. *Reophax nana* Rhumbler. X 70. Sta. 200.

Figs. 16, 17. *Ammobaculites* cf. *exiguus* Cushman and Bronnimann. X 70. Sta. 59.

Fig. 18. *Reophax curtus* Cushman. X 50. Sta. 174.

Fig. 19. *Reophax dentaliniformis* H. B. Brady. X 50. Sta. 101.

Figs. 20, 21. *Ammobaculites* cf. *foliaceus* (H. B. Brady). X 50. Sta. 171.

Fig. 22. *Labrospira crassimargo* (Norman). X 42. Sta. 186.

Fig. 23. *Ammobaculites* cf. *dilitatus* Cushman and Bronnimann. X 50. Sta. 200.

Figs. 24, 25. *Ammoscalaria fluvialis* n.sp. X 50. (24) Holotype; (25) Paratype. Sta. 59.

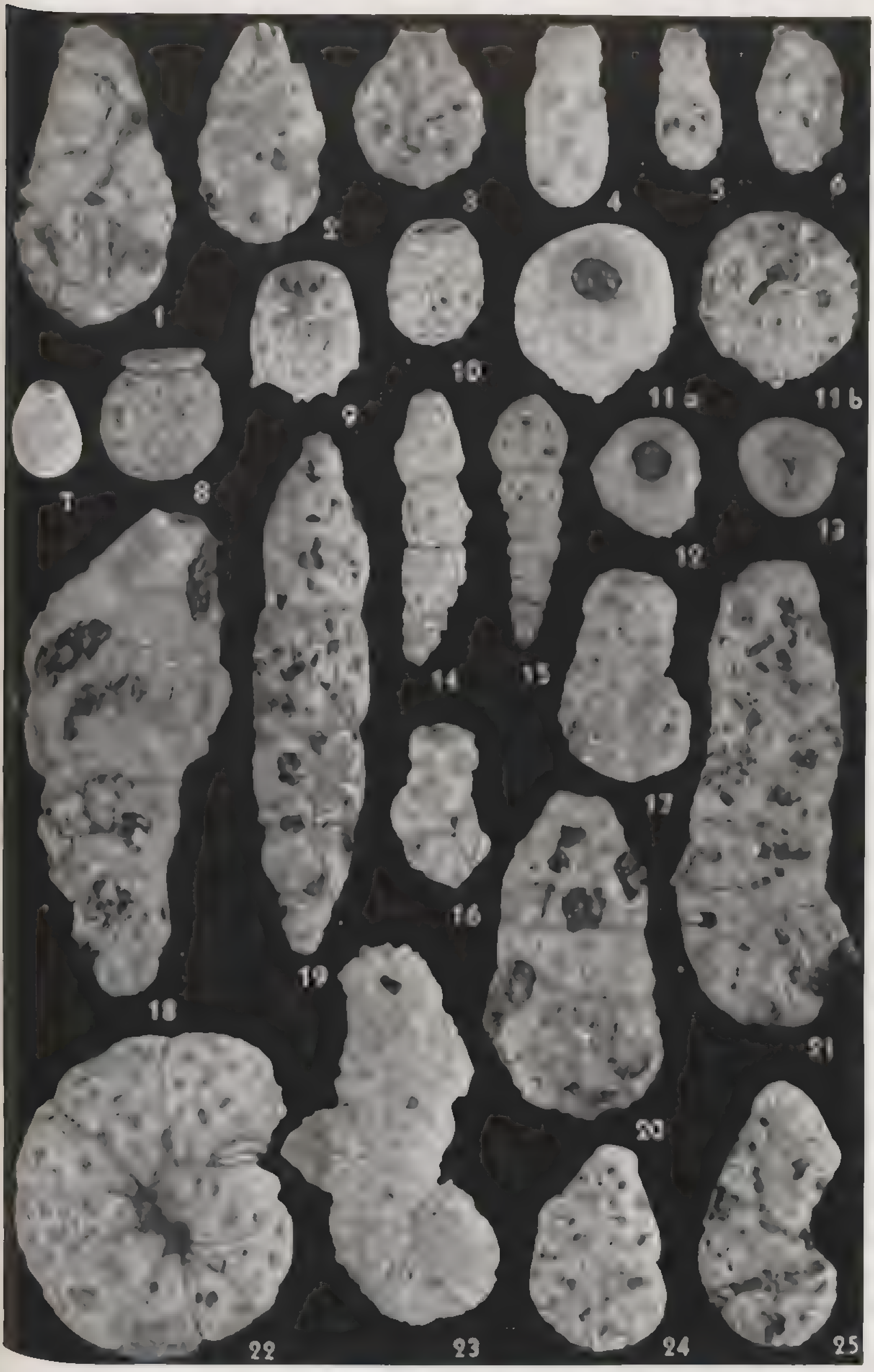
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PLATE 2

Figs. 1, 2. *Ammoastuta salsa* Cushman and Bronnimann. X 70. Sta. 13.

Fig. 3. *Eggerella advena* (Cushman). X 50. Sta. 111.

Figs. 4, 5. *Textularia* cf. *tenuissima* Earland. X 70. (4) Sta. 200; (5) Sta. 109. (see footnote, p. 458)

Figs. 6a, b. *Miliammina fusca* (H. B. Brady). X 70. Sta. 24.

Figs. 7a, b. *Quinqueloculina seminula* (Linné). X 50. Sta. 105.

Figs. 8a, b. *Quinqueloculina seminula* (Linné) var. *jugosa* Cushman. X 50. Sta. 105.

Figs. 9a, b, 10a, b. *Quinqueloculina subrotunda* (Montagu). X 50. Sta. 114.

Figs. 11a, b. *Triloculina brevidentata* Cushman. X 50. Sta. 105.

Fig. 12. *Pyrgo striatella* (Cushman). X 50. Sta. 180.

Figs. 13a, b, 14a, b, 15a, b. *Trochammina compacta* n.sp. X 70. (13) Holotype; (14, 15) Paratypes. Sta. 199.

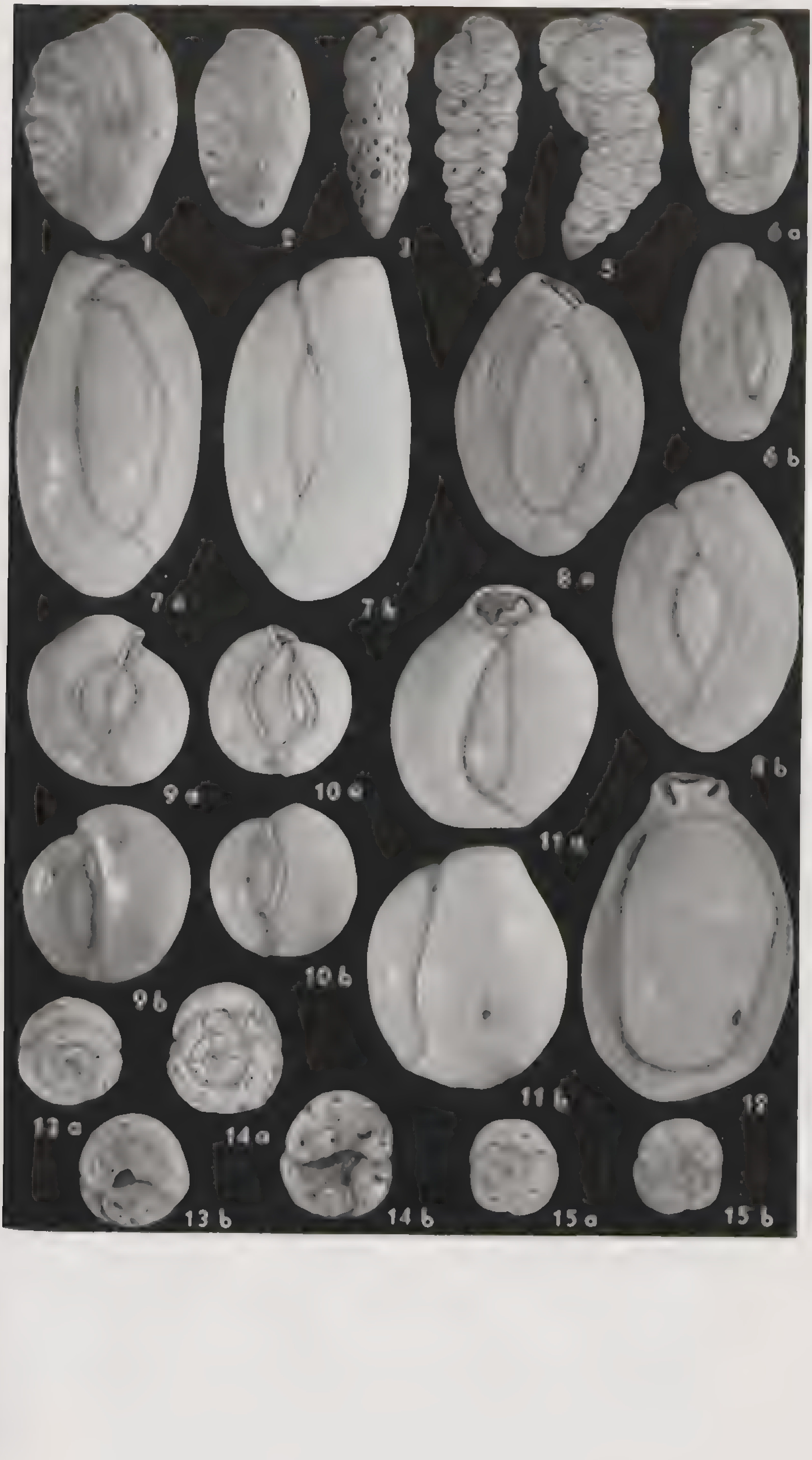
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PLATE 3

Figs. 1a, b. *Trochammina inflata* (Montagu). X 50. Sta. 64.

Figs. 2a, b. *Trochammina lobata* Cushman. X 50. Sta. 111.

Figs. 3a, b. *Trochammina macrescens* H. B. Brady. X 50. Sta. 14.

Figs. 4a, b. *Trochammina squamata* Parker and Jones. X 70. Sta. 111.

Figs. 5a, b. *Trochammina ochracea* (Williamson). X 70. Sta. 82.

Fig. 6. *Globulina caribaea* d'Orbigny. X 50. Sta. 130.

Figs. 7, 8. *Nonion tisburyensis* Butcher. X 50. (7) Sta. 105; (8) Sta. 100.

Fig. 9. *Elphidium advenum* (Cushman). X 70. Sta. 196.

Fig. 10. *Elphidium advenum* (Cushman) var. *margaritaceum* Cushman. X 50. Sta. 105.

Figs. 11, 12. *Pseudopolymorphina novangliae* (Cushman). X 50. (11) Sta. 196; (12) Sta. 204.

Fig. 13. *Elphidium excavatum* (Terquem). X 50. Sta. 201.

Figs. 14, 16, 17. *Elphidium incertum* (Williamson) variants. X 50. (14) Sta. 105; (16) Sta. 65; (17) Sta. 111.

Figs. 15a, b. *Nonionella atlantica* Cushman. X 50. Sta. 119.

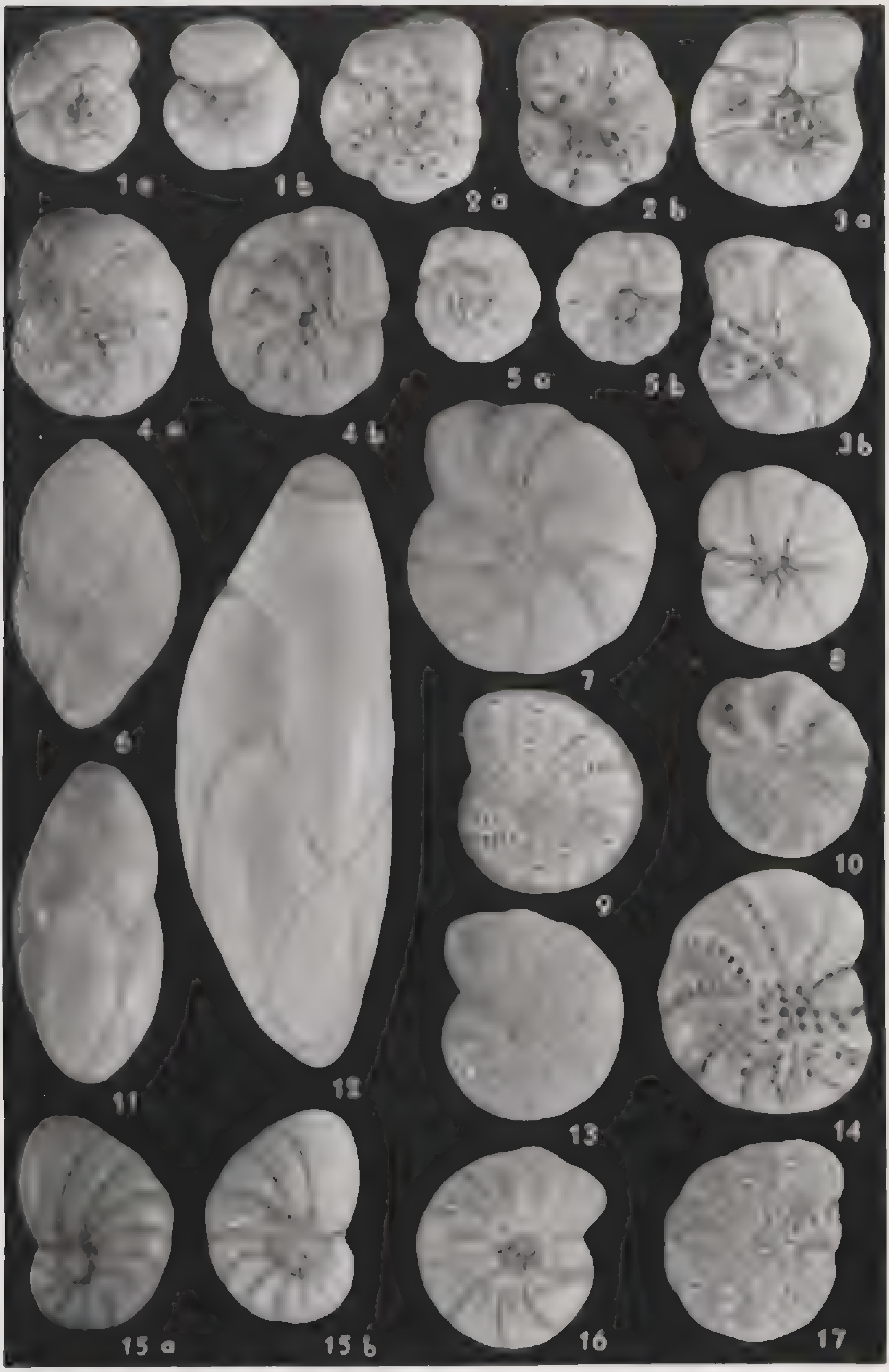
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PLATE 4

Figs. 1, 2. *Elphidium incertum* (Williamson) variants. X 50. Sta. 65.

Figs. 3, 4, 5, 6, 8. *Elphidium subarcticum* Cushman. (3–6) X 50. Sta. 105: (8) X 70. Sta. 29.

Figs. 7, 13. *Bulimina* aff. *aculeata* d'Orbigny. X 70. (7) Sta. 179; (13) Sta. 176.

Fig. 9. *Elphidium selseyensis* (Heron-Allen and Earland). X 50. Sta. 196.

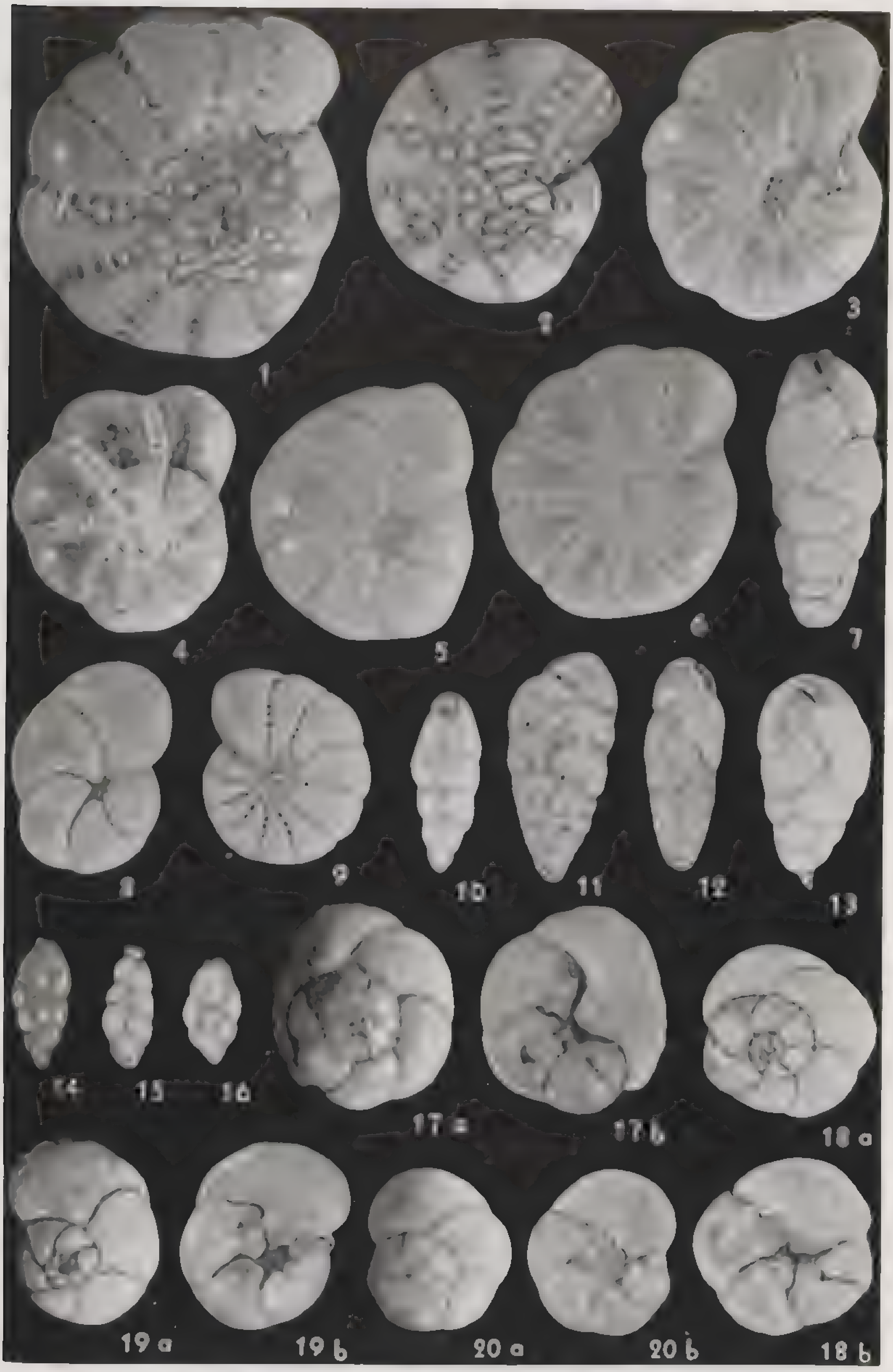
Fig. 10. *Virgulina fusiformis* (Williamson). X 70. Sta. 194.

Fig. 11. *Bolivina pseudoplicata* Heron-Allen and Earland. X 70. Sta. 176.

Fig. 12. *Bolivina variabilis* (Williamson). X 70. Sta. 130.

Figs. 14, 15, 16. *Hopkinsina pacifica atlantica* Cushman. X 70. Sta. 194.

Figs. 17a, b, 18a, b, 19a, b, 20a, b. *Discorbis columbiensis* Cushman. X 50. (17, 20) Sta. 176; (18, 19) Sta. 114.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18 b

PLATE 5

Figs. 1a, b. *Discorbis squamata* Parker. X 70. Sta. 126.

Figs. 2a, b. *Eponides frigidus* (Cushman). X 70. Sta. 145.

Figs. 3a, b. *Eponides frigidus* (Cushman) var. *calidus* Cushman and Cole. X 50. Sta. 100.

Figs. 4a, b. *Eponides wrightii* (H. B. Brady). X 50. Sta. 105.

Fig. 5a, b. *Rotalia beccarii* (Linné). X 50. Sta. 105.

Figs. 6a, b. *Poroeponides lateralis* (Terquem). X 50. Sta. 114.

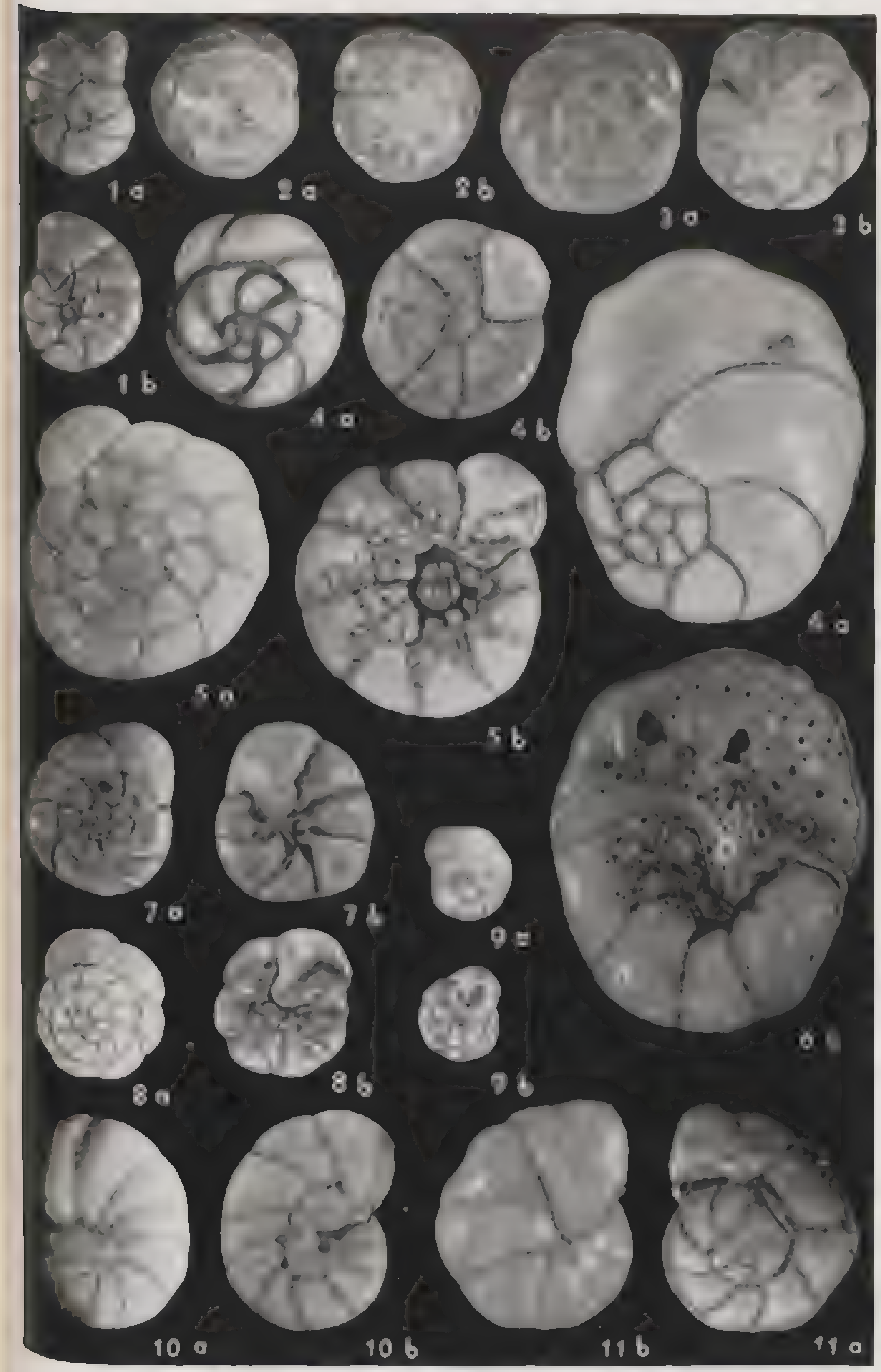
Figs. 7a, b. *Rotalia beccarii* (Linné) var. *sobrina* Shupack. X 50. Sta. 105.

Figs. 8a, b. *Rotalia beccarii* (Linné) var. *tepida* Cushman. X 50. Sta. 202.

Figs. 9a, b. *Pninaella* (?) *pulchella* Parker. X 82. Sta. 127.

Figs. 10a, b. *Cibicides concentricus* (Cushman). X 50. Sta. 180.

Figs. 11a, b. *Cibicides lobatulus* (Walker and Jacob). X 50. Sta. 176.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Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE
Vol. 106, No. 11

REVISIONARY STUDIES OF SOME SOUTH AMERICAN TEIIDAE

By Rodolfo Ruibal

CAMBRIDGE, MASS., U.S.A.
PRINTED FOR THE MUSEUM

June, 1952

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REVISIONARY STUDIES OF SOME SOUTH AMERICAN TEIIDAE

By Rodolfo Ruibal

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June, 1952

No. 11.—*Revisionary Studies of Some South American Teiidae*[1]

By Rodolfo Ruibal

INTRODUCTION

As is well known to most students of South American herpetology, the small specialized teiids of this continent represent a bewildering array of species and genera, few of which are in a satisfactory taxonomic condition. Since the publication of Boulenger's second volume of the "Catalogue of Lizards in the Collection of the British Museum" in 1885, very few adequate generic revisions have been attempted. Burt and Burt's "South American Lizards in the Collection of the American Museum of Natural History" in 1931 attempted to summarize and clarify the generic and specific characters of some of the forms, but with very limited success. Nevertheless, this work and their check list of South American lizards published in 1933, has been of considerable value as a reference source.

The greatest problem in attempting any revision of South American teiids is the scarcity of representative material in the museums. Furthermore, the inadequate descriptions of some of the species, and the impossibility of examining all of the type specimens, make a satisfactory revision difficult.

In this paper an attempt has been made to revise *Leposoma, Cercosaura, Alopoglossus,* and *Pantodactylus*. These genera have been chosen because examples of all the species were available. Keys for the species of these four genera have been prepared. However, it is impossible to devise a key for the genera of "micro-teiids" until more of the genera are studied and redefined in the light of the many species described since the publication of Boulenger's Catalogue.

All generic as well as specific descriptions have been rewritten on the basis of the specimens examined. Any character that is common to all the species is given in the generic definition, but is usually not mentioned again in the description of the species.

The terminology has been standardized throughout and consequently it differs from that used in some of the original descriptions. The term loreal is reserved for the scale posterior to the nasal and anterior to the first superciliary; the frenoocular is the scale below the loreal and anterior to the eye, which in some cases comes in contact with the nasal, and consequently separates the loreal from the

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[1] Manuscript received for publication October 11, 1951.

upper labials. Whether these scales are homologous in the different genera is not known; however, for clarity I believe that it is excusable to consider them as such. The pregulars are the scales anterior to an imaginary line linking one ear opening to another and lying between the more posterior postmentals. The gulars are the scales between this ear line and the collar.

The scale count at the midbody includes the ventrals, laterals, and dorsals. Counting the ventrals and dorsals separately at the midbody is often accompanied by a wide margin of error since it is difficult to delimit the ventrals in many cases. The number of transverse rows of dorsals was determined by counting from the posterior margin of the hind limbs to, and including, the nuchals. In the species that lack well developed nuchals and postparietals, the count was made to include the row of scales bordering the interparietal and parietals posteriorly. The number of transverse rows of ventrals was made by counting from the row posterior to the collar to, and including, the anterior preanals. The number of transverse rows of gulars was ascertained by counting from the collar to the ear line.

I wish to express my thanks to Mr. Arthur Loveridge of the Museum of Comparative Zoölogy (M.C.Z.) and Mr. Charles M. Bogert of the American Museum of Natural History (A.M.N.H.) for their advice and assistance, as well as the free use of their respective departments. I am indebted to Mr. Max Spier and Mr. Samuel Horowitz of New York City, and Mrs. Bessie M. Hecht of the American Museum of Natural History, as well as Dr. Ernest Williams of Harvard University and Mr. Benjamin Shreve of the Museum of Comparative Zoölogy for their assistance on many occasions. To Mr. J. C. Battersby of the British Museum (Natural History), I am thankful for examining specimens in the Museum's collection. To Dr. Paulo Vanzolini of the Museo de São Paulo, Departamento de Zoologia, Brasil (D.Z.) and Dr. Emmett Reid Dunn of the Academy of Natural Sciences of Philadelphia (A.N.S.P.) I owe my thanks for their pertinent advice as well as the loan of material. The loan of additional specimens was made possible by the courtesy of the following persons: the late Dr. Harvey Bassler of the American Museum of Natural History; Dr. Doris M. Cochran of the United States National Museum (U.S.N.M.); Dr. Norman E. Hartweg of the University of Michigan Museum of Zoology (U.M.M.Z.); Dr. Grace Orton of the Carnegie Museum (C.M.); and Mr. Clifford H. Pope of the Chicago Natural History Museum (C.N.H.M.).

The abbreviations designated above in parentheses will be used throughout the text to denote the respective museums.

The taxonomic alterations included in this paper are summarized below.

The new species and subspecies proposed are:

Leposoma annectans sp. nov.
Leposoma guianense sp. nov.
Alopoglossus andeanus sp. nov.
Cercosaura ocellata bassleri subsp. nov.
Cercosaura ocellata petersi subsp. nov.
Pantodactylus schreibersii parkeri subsp. nov.

The following genera have been placed in synonymy:

Mionyx Cope = *Leposoma* Spix
Loxopholis Cope = *Leposoma* Spix

The following species have been placed in synonymy:

Leposoma bisecta Taylor = *Leposoma southi* Ruthven and Gaige
Leposoma dispar Peters = *Leposoma rugiceps* (Cope)
Alopoglossus amazonius Ruthven = *Alopoglossus carinicaudatus* (Cope)
Alopoglossus copii surinamensis Brongersma = *Alopoglossus carinicaudatus* (Cope)
Pantodactylus femoralis Vanzolini = *Pantodactylus quadrilineatus* Boettger

The generic allocation of the following species has been changed as indicated:

Mionyx parietalis Cope becomes *Leposoma parietale* (Cope)
Alopoglossus plicatus Taylor becomes *Ptychoglossus plicatus* (Taylor)
Prionodactylus quadrilineatus (Boettger) becomes *Pantodactylus quadrilineatus* Boettger
Loxopholis rugiceps Cope becomes *Leposoma rugiceps* (Cope)
Pantodactylus tyleri Burt and Burt becomes *Arthrosaura tyleri* (Burt and Burt)

The species of *Leposoma, Cercosaura, Alopoglossus,* and *Pantodactylus* that are recognized in this paper are listed below:

Leposoma scincoides Spix
Leposoma annectans sp. nov.
Leposoma percarinatum (Müller)
Leposoma guianense sp. nov.
Leposoma parietale (Cope)
Leposoma rugiceps (Cope)
Leposoma southi Ruthven and Gaige
Cercosaura ocellata ocellata Wagler
Cercosaura ocellata bassleri subsp. nov.
Cercosaura ocellata petersi subsp. nov.
Alopoglossus buckleyi (O'Shaugnessy)

Alopoglossus carinicaudatus (Cope)
Alopoglossus andeanus sp. nov.
Alopoglossus copii Boulenger
Alopoglossus festae Peracca
Pantodactylus schreibersii schreibersii (Wiegmann)
Pantodactylus schreibersii albostrigatus (Griffin)
Pantodactylus schreibersii parkeri subsp. nov.
Pantodactylus quadrilineatus Boettger

Genus LEPOSOMA Spix

Leposoma Spix, 1825, Spec. Nov. Lacert. Bras., p. 24.
Lepidosoma Wagler, 1830, Nat. Syst. Amphibiens, p. 157.
Lepisoma Gray, 1845, (in part), Cat. Liz. Brit. Mus., p. 60.
Loxopholis Cope, 1868, Proc. Acad. Nat. Sci. Philadelphia, p. 305.
Leposoma Peters, 1880, Monatsb. Akad. Wiss. Berlin, p. 309.
Mionyx Cope, 1885, Proc. Amer. Philos. Soc., vol. 23, p. 96.
Hylosaurus Müller, 1923, Zool. Anz., vol. 57, p. 146.

In 1868 *Loxopholis rugiceps* was described by Cope on the basis of a specimen collected in the Rio Magdalena region of Colombia. In 1880 Peters described *Leposoma dispar* from Caceres, on the Rio Cauca in Colombia. *Loxopholis* was considered to be generically distinct due to the presence of smooth ventral scales. An examination of the type and other specimens of *rugiceps* demonstrated that *rugiceps* and *dispar* are identical. The condition of the ventrals is not correlated with geographic distribution, since specimens from the same locality may have keeled or smooth ventrals. Consequently, *Loxopholis* is included in the synonymy of *Leposoma,* and *dispar* placed in the synonymy of *rugiceps.* E. R. Dunn had previously arrived at the same conclusion and has graciously given me the information he had on the subject.

The genus *Mionyx* Cope was described in 1885 from a specimen collected at Pebas, Ecuador. Its inclusion in the synonymy of *Leposoma* is based upon the examination of specimens from Ecuador, Colombia and Peru that compare perfectly with Cope's description of *Mionyx parietalis* except for two points: Cope's description states that *parietalis* has smooth head plates and a reduced first toe on the fore and hind limbs, bearing a rudimentary straight claw. The specimens examined all have striated head scales and the first toes, though reduced, have a small curved claw. Cope, however, further states that the type specimen was in poor condition. I have found that if the cuticle of the head scales is removed the striations disappear. This, I believe, had occurred in the type specimen, the smooth head scales being the result of poor preservation. The presence of a straight, rather than a curved, claw on the inner toes cannot be reconciled, unless we consider this observation a mistake on Cope's part or believe that the similarity between the specimens examined and the description outweighs this difference.

Little is known of the habits of *Leposoma*. All of the specimens examined were from localities below 600 meters (2,000 feet)[1]. Ruthven (1922) found *rugiceps* in damp leaves, under logs and amidst the grass of a marsh. The field notes of a specimen of *percarinatum* from British Guiana state that it was found (along with a specimen of *Arthrosaura reticulata vesteegi*) crawling under dead leaves on the edge of a dried creek bed. Müller's type specimen of *percarinatum* was found on the leaves of a forest floor in Pará, Brasil.[2]

Generic definition. Tongue with imbricate scale-like papillae. Head scales with longitudinal striations and consisting of: single or divided frontonasal; pair of prefrontals; frontal; pair of frontoparietals; parietals and an interparietal; no occipital or postparietals; nostril in a divided or single nasal; loreal small and separated from the upper labials by the frenoocular (fig. 2); supraoculars 4, the first and fourth smaller than the second and third; first superciliary large and without dorsal expansion; palpebrals 2–5; suboculars small; upper labials 6–7; lower labials 5–6; first postmental single and followed by 3 pairs of postmentals. Dorsals keeled, imbricate and mucronate, in transverse and diagonal rows. Laterals like the dorsals. Ventrals keeled or smooth, truncate or pointed, subimbricate or imbricate. Gulars equal in size, pointed, and in transverse and diagonal rows. Collar indistinct. Femoral and preanal pores in males, females with preanal pores but without femoral pores.

Key to the species of Leposoma

1. Frontonasal longitudinally divided 2
   Frontonasal single 4
2. Pregulars flat and quadrangular; ventrals in longitudinal rows; range: Costa Rica, Panama (above Canal Zone), and Barro Colorado Island, C. Z. . . . . *southi*
   Pregulars convex, posteriorly pointed; ventrals not in longitudinal rows. . 3
3. Interparietal neither longer nor broader than the parietals; third postmental in contact with the lower labials; range: Brasil . . . . *scincoides*
   Interparietal longer and broader than parietals; third postmental separated from the lower labials by a small scale; range: Baia, Brasil . . . . *annectans* sp. nov.

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[1] Altitude records were approximated from the 1:1,000,000 Maps of Hispanic America published by the American Geographical Society of New York.

[2] See W. Beebe 1945 (Zoologica, vol. 8, pt. 1, pp. 7–32) for excellent field notes on *L. percarinatum*.

4. Scales on side of neck keeled, imbricate and shaped like the dorsals; 27–31 scales from parietals to posterior margin of hind limbs; range: Canal Zone, Panama (below Canal Zone), and Colombia . . . . *rugiceps*
   Scales on side of neck not shaped like the dorsals; 32–39 scales from parietals to posterior margin of hind limbs 5
5. Preanal scales 5, medial preanal large, elongate (fig. 1); female with uniform body color; range: Dunoon, British Guiana . . . . *guianense* sp. nov.
   Preanal scales 5, medial preanal much smaller than other preanal scales; female body color not uniform 6
6. An irregular dorsolateral dark stripe 1 or 2 scales wide, extending onto the tail where it is bordered below by a white stripe originating at insertion of hind limb; 36–39 scales from parietals to posterior margin of hind limbs; range: northeastern South America . . . . *percarinatum*
   A dark lateral band 4–5 scales wide; no white stripe on tail; 32–36 scales from parietals to posterior margin of hind limbs; range: southern Colombia, eastern Ecuador, and northeastern Peru . . . . *parietale*

LEPOSOMA SOUTHI Ruthven and Gaige

Leposoma southi Ruthven and Gaige, 1924, Occas. Papers Mus. Zool., Univ. Michigan, no. 147, p. 1.

Leposoma dispar Burt and Burt, 1931, (in part), Bull. Amer. Mus. Nat. Hist., vol. 61, p. 347.

Leposoma bisecta Taylor, 1949, Univ. Kansas Sci. Bull., vol. 33, pt. 1, no. 5, p. 275.

Type locality. Progreso, Chiriqui Province, Panama.

Description. Frontonasal longitudinally divided; prefrontals in broad contact medially; frontal long and hexagonal; frontoparietals slightly larger than prefrontals; interparietal longer than parietals, but no wider than the parietals at their greatest width. All dorsal head plates with marked longitudinal striations. Nostril in a divided nasal, the suture of the nasal passing through or posterior to the nostril; superciliaries 4; suboculars 5–7; palpebrals 2–4; temporal scales keeled; upper labials 6, the sixth being the largest and bearing a longitudinal keel upon its lower surface; lower labials 5–6; single postmental followed by 2 pairs of postmentals in contact medially, the second pair of postmentals the largest; a third pair of postmentals not in contact medially nor with the lower labials; the pregulars may be keeled, but are quadrangular and non-imbricate; side of neck covered with large conical scales.

Dorsals leaf-shaped, broad; laterals like the dorsals. Ventrals keeled, imbricate and mucronate, more hexagonal in shape than the dorsals and in longitudinal and transverse rows. Gular scales keeled, imbricate and in transverse and diagonal rows. A collar is present but

SUMMARY OF DATA FOR SPECIES OF *LEPOSOMA*

(Mean value of scale counts is in parentheses below extreme values)

Species	No. of Specimens	Sex Ratio ♂/♀	Maximum Snout to Vent Length (mm.)	SCALE COUNTS Midbody	Transverse Dorsal Rows	Transverse Ventral Rows	Gulars
rugiceps	30	15/14	44	20–25 (22.9)	27–31 (28.8)	22–24 (22.7)	8–10
parietale	9	4/5	36	23–28 (25.2)	32–36 (34.0)	21–23 (22.1)	9–10
percarinatum	19	0/19	35	24–29 (25.9)	36–39 (37.4)	24–28 (26.0)	9–10
southi	12	6/6	35	20–25 (22.4)	28–33 (30.2)	20–24 (21.6)	7–10
guianense	2	0/2	37	24	33	22	9–10
scincoides	1	0/1	45	25	32	22	8
annectans	1	0/1	37	24	29	21	8

is indistinct. Caudals and subcaudals keeled and in longitudinal and transverse rows. Scales of the limbs keeled and imbricate. Inner toe of forelimb reduced, with only 2 segments. Posterior preanals consist of a small median scale bordered by 2 larger scales on each side. The anterior preanal is a single large median scale or 3 median scales. All preanal scales keeled. Males with 2 preanal pores and 4/4 femoral pores; females with 2 preanal pores only.

Scale counts. Midbody, 20–25; transverse dorsal rows, 28–33; transverse ventral rows, 20–24; gulars, 7–10.

Color. Overall color dull-brown. Top of head a darker brown. Laterally from the head to the proximal portion of the tail a darker brown than the dorsum. Lower labials heavily pigmented. White scales or ocelli may be present on the side of the neck and above the forelimb. The males tend to be more heavily pigmented than the females. Underside of head, gular region and abdomen cream colored and spotless, though marginal spotting of the postmentals may be present. Venter of tail with dark blotches.

Remarks. Burt and Burt (1931) incorrectly placed *southi* in the synonymy of *rugiceps* (*dispar*).

The possibility that *southi* and *rugiceps* are subspecies has been considered, but no substantiating evidence has been found. Both species are readily distinguishable, by color as well as scalation, and none of the specimens from the possible intergrade area — the Canal Zone — shows signs of hybridization. It appears that the two species are allopatric even in the Canal Zone. The range of *rugiceps* extends into the Canal Zone but not to Barro Colorado Island, while *southi* is found from southern Costa Rica to Barro Colorado Island. Collecting on Barro Colorado has been intensive enough to warrant the assumption that *rugiceps* does not occur there.

Taylor (1949) described *L. bisecta* from Costa Rica without reference to *southi* since he followed Burt and Burt in considering *southi* synonymous with *dispar*. The type locality of *southi* is Progreso, near the Costa Rican border of Chiriqui Province, on the Pacific side of Panama. Taylor's specimen was collected at El General (San Isidro del General?) on the Pacific Slope of Costa Rica. The only differences in scalation between *bisecta* and *southi* are that *bisecta* has "26 scales in row about middle of body," and "35 rows from chinshields to preanal pore-scales." In contrast the maximum midbody scale count of *southi* specimens examined is 25 and the maximum chinshields to preanal pore-scales is 34. This difference is not significant and is probably the result of different counting techniques. Taylor's type is further characterized by having 7/7 femoral pores, in contrast to 4/4 femoral pores in the male specimens of *southi* examined. However, since there is identity with *southi* in all other characters, *bisecta* is placed in the synonymy of *southi*.

Specimens examined. COSTA RICA: Suretka, Rio Sixaola, M.C.Z. 18916–17. PANAMA: Barro Colorado Island, Canal Zone, M.C.Z. 22298, U.M.M.Z. 63625–27; Progreso, Chiriqui Province, M.C.Z. 18915, U.M.M.Z. 58053 (paratype), 58065B (paratype), 58486, and 58484; El Valle, Cocle Province, A.N.S.P. 21088.

LEPOSOMA SCINCOIDES Spix

Leposoma scincoides Spix, 1835, Spec. Nov. Lacert. Bras., p. 24.
Lepisoma scincoides Gray, 1845, (in part), Cat. Liz. Brit. Mus., p. 60.
Lepidosoma scincoides Tschudi, 1847, Arch. f. Nat., p. 45.
Lepidosoma scincoides Peters, 1862, Abhandl. Akad. Wiss., Berlin, p. 190.
Leposoma scincoides Boulenger, 1885, Cat. Liz. Brit. Mus., vol. 2, p. 386.

Type locality. Amazon River.

Description. Frontonasals longitudinally divided, the posterior borders concave and in contact with the first supraocular and prefrontals; prefrontals in contact medially; frontal hexagonal and bordered laterally by the second and part of the third supraocular; frontoparietals in contact medially and slightly larger than the prefrontals; interparietal narrower and equal in length to the parietals. All head scales with longitudinal striations. Nostril in a nasal that is grooved dorsally; superciliaries 5; palpebrals 3; suboculars 5; temporals keeled; upper labials 6; lower labials 5, of which the second is the largest. A single mental followed by 2 pairs of postmentals in contact medially, the second pair being the largest; a third pair of postmentals separated medially by 2 keeled and imbricate scales and in contact laterally with the lower labials. Pregular scales convex and posteriorly pointed.

Dorsals hexagonal, longer than wide. Side of neck with very small, keeled, non-imbricate scales. Gulars and ventrals longer than wide, keeled, imbricate and mucronate, in transverse and diagonal rows rather than longitudinal. An indistinct collar fold. A single median anterior preanal; posterior preanals 5, the median scale the smallest. Scales of the forelimbs keeled and imbricate; on hind limbs also keeled and imbricate except for the posterior surface of femur that bears flat, non-imbricate scales. Tail with keeled and imbricate scales on ventral and dorsal surface; the scales are arranged in diagonal and transverse series but *not* in longitudinal rows. The specimen is a female and has 2 preanal pores but no femoral pores.

Scale counts. Midbody, 25; transverse dorsal rows, 32; transverse ventral rows, 22; gulars, 8.

Color. It is impossible to give a color description from the specimen examined since it is completely faded. Peters (1862) describes the type specimen as having the head, tail and ground color of dorsum a dark yellow-brown, the dorsum having from 3 to 4 longitudinal series of irregular dark flecks and the ventral region being yellow-gray.

Remarks. In Peters' description (1862) of the type specimen the frontonasal is described as single. However, the excellent illustration of the type accompanying the description shows a faint longitudinal line running the length of the frontonasal. In the single specimen that I have examined, the frontonasal is divided as in the drawing, but the specimen corresponds perfectly with Peters' description on all other characters.

The type locality of *scincoides* is given by Spix as the Amazon River. It is, therefore, surprising that the single specimen of *scincoides* available to the author bears as its locality Ipiranga, on the outskirts of São Paulo, Brasil.[3] It is difficult to believe that a species of *Leposoma* covers so immense and varied a region as the above localities indicate. It appears probable that one of the two localities is an error.

Some may be of the opinion that the distinctness of *scincoides* warrants generic separation of all other species of *Leposoma*. What distinguishes *scincoides* from the other species thus far described are the elongate dorsals, narrow interparietal, the convex pointed pregulars and the ventrals in diagonal rather than longitudinal rows. The new species, *annectans*, described below resembles *scincoides* except for the presence of a broad and enlarged interparietal such as is found in the other species of *Leposoma*. The presence of this distinctive interparietal in *annectans* indicates a close relationship between the *scincoides* group (*scincoides* and *annectans*) and the *parietale* group (all other species of *Leposoma*). Consequently, I do not believe that any useful purpose can be served by dividing this evidently monophyletic genus.

Specimens examined. BRASIL: Porto Cachoeiro, State of Espirito Santo, D.Z. 3002.

LEPOSOMA ANNECTANS sp. nov.

Type. D.Z. 790B, female, collected at Baia, State of Baia, Brasil. Snout to vent length, 37 mm.

Diagnosis. Related to *scincoides* but distinguished from that species by the presence of an enlarged interparietal and the fact that the third pair of postmentals are separated from the lower labials by a small scale. This new species can be distinguished from the other species of *Leposoma* by having the ventrals in transverse and diagonal rows.

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[3] After the completion of the manuscript Paulo Vanzolini notified the author that this locality was erroneous, and that the actual locality is in the state of Espirito Santo. This correction has been made in the text; however, the map showing the distribution of *Leposoma* has not been corrected.

Description. All head scales with sharp longitudinal striations; frontonasal divided longitudinally, in contact with the first supraocular; prefrontals in broad contact medially; frontal hexagonal; frontoparietals small and with a short medial suture; interparietal longer than the parietals, its anterior width less than its posterior width; nostril in a divided nasal; very small loreal separated from the upper labials by the larger frenoocular; palpebrals 5; temporals small and keeled; about 5 upper labials; lower labials 4, elongate; postmentals with longitudinal striations, the first single and followed by 3 pairs, the last pair separated medially and also separated from the third lower labial by a small scale.

Dorsals lanceolate-hexagonal, in diagonal and transverse rows. Laterals like the dorsals. Scales on the side of the neck small and conical. Ventrals keeled, lanceolate-hexagonal and in diagonal and transverse rows. Gulars keeled, pointed, in diagonal and transverse rows. An indistinct collar fold. Scales of the limbs keeled. Posterior preanals 5, arranged as in *scincoides*. Caudals and subcaudals keeled, hexagonal, not in longitudinal rows. The type is a female and has no femoral or preanal pores.

Scale counts. Midbody, 24; transverse dorsal rows, 29; transverse ventral rows, 21; gulars, 8.

Color. No description of color can be given since the specimen is completely faded.

LEPOSOMA RUGICEPS (Cope)

Loxopholis rugiceps Cope, 1868, Proc. Acad. Nat. Sci. Philadelphia, p. 305.
Leposoma dispar Peters, 1880, Monatsb. Akad. Wiss. Berlin, p. 309.
Pantodactylus rugiceps Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 358.

Type locality. Rio Magdalena region, Colombia.

Description. Frontonasal single, as broad or broader than long and not in contact with the first supraoculars; prefrontals in contact medially; frontal long and in contact laterally with the second supraoculars; frontoparietals slightly larger than the prefrontals; interparietal longer and usually wider than the parietals. All head scales with longitudinal striations, though in some specimens the anterior scales are devoid of striations. All specimens have only 2 large palpebrals. Superciliaries 4; suboculars small, 4–6; upper labials about 6, the fifth being the highest; lower labials 5–6; temporals large and keeled. A single anterior postmental followed by 2 pairs of postmentals in contact medially, a third smaller pair may or may not be in contact medially and are separated from the lower labials by a small scale. Pregulars small, flat and not pointed.

Dorsals leaf-shape, broad; laterals like the dorsals. The side of the neck is covered by smaller, keeled and imbricate scales. Gulars keeled and imbricate though in some specimens the median gulars are smooth. No longitudinal rows of enlarged gulars present. Ventrals may be smooth and posteriorly truncate or oval, or keeled and mucronate, in transverse and longitudinal rows. Scales of the limbs keeled except for the posterior surface of the hind limbs. Subcaudals elongate, keeled and in longitudinal and transverse rows; caudals are broader, keeled and only form longitudinal rows on the last two-thirds of the tail. A small median posterior preanal flanked by 1 or 2 larger scales on each side. A single or 3 anterior preanals. Females without preanal or femoral pores. Males with 4 preanal scales and 2/2–5/5 femoral pores.

Scale counts. Midbody, 20–25; transverse dorsal rows, 27–31; transverse ventral rows, 22–24; gulars, 8–10.

Color. The dorsum is brown and may be devoid of any markings or with the paravertebral scales having the keels dark-brown and with dark flecks on the rest of the scale. The lateral surface is darker than the dorsum, dark-brown or black, and with the tip of the scales white. The side of the neck is of the same dark color as the side of the body but with diagonal rows of white scales. Usually two diagonal rows are present, one starting at the upper border of the ear and ending above the forelimb, the other stripe originating on the lower border of the ear and terminating anterior to the forelimb. Each upper labial has a vertical or diagonal dark stripe that passes to the neighboring lower labial. The top of the head is slightly darker than the dorsum. A white stripe originates on the posterior surface of each hind limb and continues laterally along the tail. Ventrals are colorless except for the most lateral row, which shows dark flecking. The gulars and mentals show moderate to light flecking in the males but little, if any, on females. The subcaudals are spotless except for the scales bordering the vent; these may have dark flecking. The color of the juveniles is the same as that of the adults.

Remarks. Keeled ventrals appear to represent a juvenile character that may or may not be retained in adults. Of the 30 specimens examined 14 have keeled ventrals. Of these specimens, 8 are juvenile (snout to vent length less than 25 mm.) and represent the total number of juvenile specimens examined. Of the 6 adult specimens having keeled ventrals, 4 are males and 2 are females. Specimens with keeled ventrals are recorded from the Santa Marta Mountains region and the Department of Santander in Colombia, and from the Canal Zone and Juan Diaz in Panama. Specimens with smooth ventrals are recorded from the Rio Magdalena region (type), and the Santa Marta Mountains region in Colombia, and from the Canal Zone in Panama.

Specimens examined. PANAMA: Canal Zone, A.N.S.P. 23210; Ft. Clayton, Canal Zone, M.C.Z. 24392; Ft. Randolph, nr. Colon, Canal Zone, M.C.Z. 18892–93; Juan Diaz, Panama Prov., M.C.Z. 34379; Gatun, Canal Zone, M.C.Z. 22321–23, U.S.N.M. 120793–94, A.N.S.P. 20858. COLOMBIA: Rio Frio, M.C.Z. 29720–22, 29724–25; Fundacion, M.C.Z. 16834–35; Las Pavas, Santa Marta Mts., M.C.Z. 16836–37, U.M.M.Z. 56511; Santa Marta Mts., nr. Bolivar, U.M.M.Z. 54738, Santa Marta Mts., Valencia, U.M.M.Z. 54736; Santa Marta Mts. U.M.M.Z. 48214–16; Tucurinca, U.M.M.Z. 55721; A.N.S.P. 19729; El Centro, Santander, A.N.S.P. 25200; Magdalena River Region, A.N.S.P. 9635 (type).

LEPOSOMA GUIANENSE sp. nov.

Type. U.M.M.Z. 46770, adult female, collected at Dunoon, Demerara River, British Guiana, by A. G. Ruthven, on July 27, 1914. Snout to vent length 37 mm.

Paratype. U.M.M.Z. 46768, female with the same data as the type. Snout to vent length 27 mm.

Diagnosis. Related to *L. percarinatum* from which it differs in having an elongate median preanal (fig. 1) instead of a small triangular one and in having larger body scales, 33 transverse dorsal rows, instead of 36–39, and a proportionately larger interparietal.

Description of type. Frontonasal single and as long as broad, and not in contact with the first supraocular; prefrontals in broad contact medially; frontal hexagonal; frontoparietals as large as prefrontals; interparietal very large, having twice the width and length of a single parietal. Nostril in an undivided nasal; superciliaries 4; palpebrals 4; suboculars 5; temporals small and keeled; upper labials 7, the sixth being the largest; lower labials 5–6, the third the largest. A single mental followed by 2 pairs of postmentals in contact medially, the second pair being larger than the first. A third pair of postmentals separated medially by a small scale and laterally not in contact with the lower labials. A smooth flat pregular scale behind each third postmental.

Dorsals leaf-shaped, about as broad as long. Side of neck with granular scales. Gulars keeled and mucronate and in diagonal and transverse rows only. An indistinct collar fold. Ventrals in longitudinal and transverse rows, keeled, imbricate and mucronate, shaped like the dorsals but narrower. Preanal scales consisting of 5 elongate keeled scales (fig. 1). Two preanal pores. Tail with scales in longitudinal and transverse rows, all keeled and mucronate, but the subcaudals are narrower than the caudals. Forelimbs with keeled scales except for inferior surface of humerus; inner toe with 3 segments. Hindlimbs having keeled scales except for posterior surface of femur.

Scale counts. Midbody, 24; transverse dorsal rows, 33; transverse ventral rows, 22; gulars, 10.

Color. A uniform brown dorsum without trace of any lateral or dorsolateral markings. Gular region and abdomen spotless. Lateral portion of second and third postmental with brown blotches. No white stripe on the lateral region of tail, dorsally the tail is brown and ventrally heavily splotched with brown.

Remarks. The paratype is identical with the type in all respects, varying only in having 9 gular rows instead of 10.

This new species is distinct from all other *Leposoma* in having the median preanal elongate and enlarged. It is possible that *guianense* is sympatric with *percarinatum* since a specimen of this species was also collected at Dunoon.

The interparietal in *guianense* is much larger than the parietals, much more so than in any other species of *Leposoma*. In all the species of *Leposoma*, except *scincoides*, the interparietal is always longer than the parietals. Furthermore the anterior width of the interparietal is always less than the posterior width. However, in *rugiceps* and *parietale*, the maximum width of the interparietal is in some specimens equal to the width of the parietals. In *southi* the width of the interparietal is always equal to that of the parietals.

LEPOSOMA PERCARINATUM (Müller)

Hylosaurus percarinatus Müller, 1923, Zool. Anz., vol. 57, p. 146.
Leposoma taeniata Noble, 1923, Zoologica, vol. 3, no. 15, p. 303.
Hylosaurus muelleri Mertens, 1925, Senckenbergiana, vol. 7, p. 76.
Leposoma percarinatum Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 349.

Type locality. Peixeboi, State of Para, Brasil.

Description. A single frontonasal as broad as long and not in contact with the first supraocular; frontal long and hexagonal though at times it may be octagonal; frontoparietals slightly larger than prefrontals; interparietal longer and broader than parietals. The nostril is in a divided or single nasal; palpebrals 3–5. Suboculars small 6–7; the temporals are small and keeled. Upper labials 6, the sixth being the largest; lower labials 5–6. A single postmental and 2 pairs of postmentals in contact medially, the second pair being the larger. A third pair of postmentals not in contact medially nor in contact with the lower labials. Pregular flat and quadrangular.

Dorsals leaf-shaped (fig. 6) about as wide as long; laterals like the dorsals; ventrals keeled and mucronate and in longitudinal and transverse rows. Gulars keeled and in transverse and diagonal rows or in irregular longitudinal rows. Caudals and subcaudals in longitudinal and transverse rows; the longitudinal rows of caudals not evident at the base of the tail. The subcaudals are narrower than the caudals. Scales of the limbs keeled. Inner toe of forelimb with 3 segments. Inner toe of hind limb with 3 or 4 segments. All the specimens examined are females and have 2 preanal pores with the exception of 2 specimens that have no pores.

Scale counts. Midbody, 24–29; transverse dorsal rows, 36–39; transverse ventral rows, 24–28; gulars, 9–10.

Color. Over-all color reddish-brown. An irregular dark stripe 1–2 scales wide, extends along both sides of the dorsum. Each stripe originates on the side of the neck, passes above the fore and hind limbs and extends for a short length on the tail where it is bordered inferiorly by a white stripe originating at the insertion of the hind limb. In some specimens the dorso-lateral stripe may be broken in an irregular fashion due to the failure of some scales to contain as much pigment as others.

Remarks. Hylosaurus percarinatus Müller has been shown by Burt and Burt (1931) to be identical with *Leposoma taeniata* Noble. The Burts further contended that *Hylosaurus* was not only a preoccupied name but had no reason to be considered a genus distinct from *Leposoma.* Contrary to Müller's assertion, *L. scincoides* does have a collar, but it is indistinct, as in *Hylosaurus.* Mertens in 1925 described *Hylosaurus muelleri* from "Inirida," Venezuela. The diagnostic characters of *muelleri,* according to Mertens, are an octagonal frontal, tricuspid maxillary teeth, and 12 scales to the collar. Burt and Burt (*supra cit.*) included *muelleri* in the synonymy of *percarinatum.* I have examined specimens from Venezuela and British Guiana and find that the maxillary teeth may be bi- or tricuspid and that the frontal is occasionally octagonal. The number of scales to the collar I find to be a very inaccurate character, inasmuch as it is difficult to determine the exact number of scales. Since the distinguishing characters of *muelleri* and *percarinatum* are indiscriminately present in the specimens examined, it is impossible to consider *muelleri* as distinct from *percarinatum.* It is necessary to say that "Inirida," the type locality of *muelleri* in Venezuela, was interpreted by Burt and Burt to be "Inirida

River, southern Venezuela." The Rio Inirida does not enter Venezuela; furthermore, I have been unable to find any locality in southern Venezuela or the upper Orinoco named Inirida. The correct locality is probably the Rio Inirida, Colombia.

The type specimens of *percarinatum*, *taeniata*, and *muelleri*, as well as the 19 specimens examined, are females. This disproportionate sex ratio, whether seasonal or actual, has prevented any description of *percarinatum* males.

Specimens examined. British Guiana: Dunoon, Demerara River, U.M.M.Z. 46769; Tukheit Hills, Potara River, U.M.M.Z. 63050; Kartabo, U.M.M.Z. 58420 (paratype of *taeniata*), A.M.N.H. 21263 (type of *taeniata*), and 46433–35; Wismar, A.M.N.H. 58981; Kamakusa, A.M.N.H. 25082; Isheartun, A.M.N.H. 61418 (3 specimens), 61419 (4 specimens). Venezuela: 12 miles north of Esmeralda, A.M.N.H. 39320; Rio Pescada, Mt. Duida, A.M.N.H. 36637; Brasil: Near Salto da Hua, Amazonas, U.S.N.M. 83573.

Leposoma parietale (Cope)

Mionyx parietalis Cope, 1885, Proc. Amer. Philos. Soc., vol. 23, p. 96.

Type locality. Pebas, eastern Ecuador.

Description. Frontonasal single and about as wide as it is long, not in contact with the first supraocular; frontal hexagonal; frontoparietals about as large as prefrontals; parietals longer and usually slightly wider than the parietals. All head scales with marked longitudinal striations. Nostril in a divided nasal; supraciliaries 4; palpebrals 3–4; suboculars 4–5; temporals small and keeled; upper labials 6–7; the sixth the largest; lower labials 5–6, the third the largest. A single postmental followed by two pairs of postmentals in contact medially, the second pair being larger than the first. A third pair of postmentals not in contact medially nor in contact with the lower labials; a flat smaller pregular bordering posteriorly each of the last postmentals.

Dorsals leaf-shaped, about as wide as long. Side of neck with small granular scales, some of which are keeled. Gulars in diagonal and transverse rows, keeled, imbricate and mucronate. Ventrals in transverse and longitudinal rows, narrower than the dorsals and also keeled, imbricate and mucronate. Posterior preanals 5, a small median scale bordered on each side by a large scale and smaller outer lateral scales. A single small anterior preanal immediately preceding the posterior median preanal. All preanals keeled. Females with 2 preanal pores, males with 6 preanal pores and from 5/5 to 6/6 femoral pores. All scales of the fore and hind limbs keeled. Inner toe of forelimb reduced with only 2 segments. Caudals in longitudinal and transverse rows, keeled, imbricate and mucronate, the subcaudals like the caudals but narrower.

Scale counts. Midbody 23–28; transverse dorsal rows, 32–36; transverse ventral rows, 21–23; gulars, 9–10.

Color. Dorsum dark-brown, sides of the body and neck darker, almost black. The dark band on the side of the body about 4 scales wide. The lateral region at the base of the tail without the white stripe that is typical of *L. percarinatum.* Side of the head darker than the top, a black stripe passing from each upper labial to each lower labial.

Remarks. It is possible that *percarinatum* is a subspecies of *parietale.* However, few specimens are available and the range of both species is poorly determined. More collecting, especially in the Amazon River region, is necessary before any conclusion can be reached.

Specimens examined. COLOMBIA: Morelia, Caqueta, A.N.S.P. 25507–08; ECUADOR: Sarayacu, M.C.Z. 38442; San Francisco, Rio Napo, U.M.M.Z. 48740–41, Napo-Pastaza, near Tena, U.M.M.Z. 48739; PERU: Rio Itaya, Iquitos Region, A.M.N.H. 56261–62; Iquitos, A.M.N.H. 56260.

Genus CERCOSAURA Wagler

Cercosaura Wagler, 1830, Naturl. Syst. Amphibien, München, p. 158.
Emminia Gray, 1845, Cat. Liz. Brit. Mus., p. 24.

The range of this monotypic genus is the most widespread of the species studied in this paper. The three subspecies of *Cercosaura ocellata* together occupy a region that extends from British Guiana to Peru, Bolivia, and Rio Grande du Sul in southern Brasil.

Due to the scarcity of specimens it has been impossible to determine accurately the distribution of each of the subspecies. The approximate range of each subspecies is given in the key presented here.

Cercosaura is predominantly a lowland form. Most of the localities are below an altitude of 700 meters; however, one locality (Chanchamayo, Colonia de Perené, Depto. de Junin, Peru) appears to be about 1,500 meters. Chanchamayo is not present on the maps of Hispanic America published by the American Geographical Society and the altitude is the maximum given in the notes of the collector, Dr. Harvey Bassler, for that locality.

This genus is closely related to *Pantodactylus*; however, *Cercosaura* can be distinguished from *Pantodactylus*, as well as all other teiid genera, by the presence of large rectangular keeled dorsals arranged in longitudinal rows (fig. 7).

Generic definition. Tongue anteriorly covered with imbricate scale-like papillae. The head scales are smooth and consist of the following: undivided frontonasal; prefrontals; frontal; elongate frontoparietals; interparietal longer than the parietals; postparietals and a median occipital; nuchals present or absent; upper temporals larger than the lower temporals; nostril in a divided or single nasal; a large single or divided loreal; triangular frenoocular; supraoculars 3; superciliaries 3–4, the first expanded dorsally; palpebrals 1–4; suboculars 4–5; upper labials 6–7, and lower labials 5–6; first postmental single and followed by 4 pairs of postmentals, the last pair being the smallest and separated medially by a pair of very large pregulars. Dorsals in longitudinal and transverse rows, imbricate, longer than broad, posterior border slightly convex and with a heavy keel. Laterals smaller than the dorsals and not in regular longitudinal rows. Scales on the side of the neck granular. Ventrals are wider than, or as wide as, long, smooth, truncate and in longitudinal and transverse rows. Gulars smooth, in 2 longitudinal rows of transversely enlarged scales. Caudals like the dorsals but smaller, the subcaudals like the ventrals and in 2 longitudinal rows. Femoral pores, but no preanal pores present.

Key to the subspecies of CERCOSAURA OCELLATA

1. Loreal large, undivided, and in contact with the upper labials..........2
   Loreal horizontally divided (fig. 3); range: eastern Peru and northwestern Bolivia..........*o. bassleri* subsp. nov.
2. Midbody scale count, 25–31; females with 2/2 or more femoral pores; range: northeastern South America..........*o. ocellata*
   Midbody scale count, 22–24; females with 1/1 or no femoral pores; range: southern Brasil and Bolivia..........*o. petersi* subsp. nov.

CERCOSAURA OCELLATA OCELLATA Wagler

Cercosaura ocellata Wagler, 1830, Naturl. Syst. Amphibien, München, p. 158.
Emminia olivacea Gray, 1845, Cat. Liz. Brit. Mus., p. 24.
Cercosaura humilis Peters, 1862, Abhandl. Akad. Wiss., Berlin, p. 180.

Type locality. Unknown. Probably somewhere in northeastern South America; Surinam?

Description. Frontonasal single, longer or as long as it is broad; prefrontals in contact medially; frontal hexagonal; frontoparietals as large as the prefrontals; a pair of large postparietals that are usually separated medially by a smaller occipital; about 4 square, flat nuchals bordering the occipital and postparietals posteriorly; 2–3 semitransparent palpebrals. The first 2 pairs of postmentals are always in

SUMMARY OF DATA FOR SUBSPECIES OF *CERCOSAURA*

(Mean value of scale counts is in parentheses below extreme values)

				SCALE COUNTS			
Species	No. of Specimens	Sex Ratio ♂/♀	Maximum Snout to Vent Length (mm.)	Midbody	Transverse Dorsal Rows	Transverse Ventral Rows	Gulars
o. ocellata	8	4/4	59	25–31 (26.8)	29–35 (32.2)	19–21 (20.0)	8–10
o. petersi	6	3/3	48	22–24 (23.0)	30–32 (31.3)	21–23 (21.8)	8–9
o. bassleri	21	10/11	63	24–34 (27.5)	30–33 (32.0)	18–22 (20.2)	7–10

contact medially, the third pair may or may not be in contact medially, whereas the last pair are separated medially by the large pregulars but are in contact with the fifth lower labial. The large pregulars are in turn separated medially by 1 or 2 longitudinal rows of small scales.

The laterals are smaller than the dorsals, irregular and keeled. The demarcation between dorsals and laterals is very sharp. The scales of the fore and hind limbs are smooth. There are 2/2–5/6 femoral pores in the males as well as the females.

Scale counts. Midbody, 25–31; transverse dorsal rows, 29–35; transverse ventral rows, 19–21; gulars, 8–10.

Color. A dorsolateral white stripe originates on the posterior margin of each eye and extends the length of the dorsum onto the tail. A pair of paravertebral white stripes are also evident and originate on the nuchal region and fade out at the base of the tail. The area between the white stripes is black. However, the dark vertebral region, between the paravertebral light stripes, may have a thin white or light stripe. In this case there are 5 longitudinal light stripes on the dorsum. Ocelli are present on the side of the body. The chin region is spotless except for the third and fourth pair of postmentals that have pigment on their lateral margins. The gulars are spotless or with a few dark flecks. All the ventrals and subcaudals have the central portion flecked with gray.

Due either to preservation or true dimorphism some of the specimens have no black pigment but are instead a reddish-brown. This is especially true of the specimens from Dunoon, British Guiana. The light longitudinal stripes, however, are still present.

Remarks. All of the males examined (4 specimens) had 2 preanal scales. In contrast 3 of the females examined had 4 preanal scales and the fourth female (D.Z. 707) had 3 asymmetrical preanal scales. The femoral pore counts on the British Guiana specimens are for the females, 3/3, 5/5 and 5/6, while the males have 4/4 and 5/6. In contrast, the female from Para has 3/2 and the males from Baia both have 2/2. It is very possible that the femoral pore count is clinal, for in specimens from Rio Grande du Sul, which are described here as a new subspecies, there are 1/1 in one specimen and no pores in the other.

Specimens examined. BRITISH GUIANA: Kartabo, A.M.N.H. 21264; Marudi, A.M.N.H. 61385; Demerara River, U.M.M.Z. 53896; Dunoon, Demerara River, U.M.M.Z. 46771–72. BRASIL: Rio Tapajoz, State of Para, D.Z. 707; Baia, D.Z. 790, 790A.

CERCOSAURA OCELLATA PETERSI subsp. nov.

This new subspecies occurs in the southern Brasilian states of São Paulo and Rio Grande du Sul and extends into central Bolivia (Provincia del Sara).

This new form has been named in honor of Wilhelm Peters whose excellent work, "Ueber *Cercosaura* und die mit dieser Gattung verwandten Eidechsen aus Südamerica," published in 1862, has been of great assistance.

Type. M.C.Z. 43300, an adult female, collected at Santa Maria, State of Rio Grande du Sul, Brasil, by L. I. Price and T. E. White. Snout to vent length 46 mm.

Paratype. M.C.Z. 43300A, an adult female, with the same data as the type. Snout to vent length 47 mm.

Diagnosis. Distinguished from all other subspecies by having a low midbody scale count, 22–24, and by the females having 1/1 or no femoral pores.

Description. Besides the characters included in the above diagnosis, this subspecies differs from *o. ocellata* in that the nuchals are irregular, not flat and quadrangular, with some bearing a blunt keel. The type and paratype are further distinguished in having the lateral scales broad and well keeled, and in that the scales of the tibia have a well developed keel. In the type the frontal is short and does not reach the second supraocular.

The type has a single palpebral, 4 preanal scales, no femoral pores, 24 scales at the midbody, 30 transverse rows of dorsals, 22 transverse rows of ventrals, and 9 gulars. The paratype has 2 palpebrals, 4 preanal scales, 1/1 femoral pores, 24 scales at the midbody, 32 transverse rows of dorsals, 21 transverse rows of ventrals, and 8 gulars.

The specimens from the State of São Paulo, Brasil, and Bolivia, though included below as representing this subspecies, are not identical to the type and paratype. The specimens from São Paulo differ in that the lateral scales are not broader than in *o. ocellata*. In these specimens the tibial scales are not so markedly keeled as in the type and paratype. The differences of the Bolivian specimens are described under the discussion of color.

One of the specimens from São Paulo is a male and has 3/3 femoral pores and 2 preanal scales. The second specimen is a female with 1/1 femoral pores and only 2 preanal scales. Both Bolivian specimens are males and have 2/2 femoral pores and 2 preanal scales.

Scale counts (All specimens, including the type and paratype): Midbody, 22–24; transverse dorsal rows, 30–32; transverse ventral rows, 21–23; gulars, 8–9.

Color. The overall color of the type is an olive-drab. Dorsolateral white stripes extend from the temporals to the tail. There is a barely distinguishable darker vertebral stripe, but no evidence of the white paravertebral stripes typical of *o. ocellata.* No ocelli are present on the sides of the body. The central portion of each ventral is lightly flecked with gray. The gulars and postmentals are spotless except for the lateral borders of the last 2 pairs of postmentals.

The paratype differs from the type in having the dorsolateral stripes more clearly defined and faint paravertebral stripes enclosing the darker vertebral region. The specimens from São Paulo have dorsolateral stripes but lack paravertebral stripes and have the ventrals very lightly pigmented. In the male from São Paulo (D.Z. 1953) there is a single ocellus above each fore limb. The Bolivian specimens differ in that the dorsolateral and paravertebral stripes are well defined in contrast to the Brasilian specimens. One of the Bolivian specimens is badly preserved and it is difficult to distinguish ocelli. However, the other specimen (C.M. 4667) is a male, and has about 10 ocelli on each side.

Remarks. All the subspecies of *Cercosaura ocellata* have 8 longitudinal rows of dorsals and 6 (rarely 8) longitudinal rows of ventrals. Consequently the reduction in the number of scale rows around the midbody is the result of the reduction in the number of lateral scales. It is evident that this can be achieved by either enlarging the lateral scales or reducing the width of the lateral region. In the type and paratype of *o. petersi* the lateral scales have become broader than in *o. ocellata*; in contrast the São Paulo specimens of *o. petersi* have lateral scales that are identical to those of *o. ocellata,* but due to the narrow lateral region have a low midbody count. The São Paulo specimens are similar to the type and paratype of *o. petersi* in color and femoral pore counts. The different methods of reducing the midbody scale count are possibly the result of different genetic mechanisms and it may be thus argued that they represent distinct subspecies. This course has not been followed because of the few specimens available for comparison and a careful analysis of the character.

It is interesting to note that one of the São Paulo specimens that has a perfect tail measures 45 mm. from snout to vent, and has a tail that measures 163 mm., more than 3 times the snout to vent length. The other specimen is also in perfect condition and measures 40 mm. from snout to vent, and 123 mm. from the vent to tip of tail.

Specimens examined. BRASIL: Cachoeira das Emas, Pirassununga, São Paulo, D.Z. 1952–53; Santa Maria, Rio Grande du Sul, M.C.Z. 43300 (type) and 43300A (paratype). BOLIVIA: Provincia del Sara, C.M. 986; Rio Surutu, Provincia del Sara, C.M. 4667.

CERCOSAURA OCELLATA BASSLERI subsp. nov.

Euspondylus simonsii Burt and Burt (not Boulenger), 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 337.

Specimens of this subspecies were incorrectly identified as *Euspondylus simonsii* by Burt and Burt. Boulenger's description of *simonsii*, though incomplete, clearly shows that his specimen is not a *Cercosaura*.

In contrast to *o. ocellata* and *o. petersi*, this subspecies is found in eastern Peru and in the northwestern corner of Bolivia.

The new subspecies is named in honor of the late Dr. Harvey Bassler, who made very extensive herpetological collections in Peru.

Type. A.M.N.H. 23191, an adult male measuring 45 mm. from snout to vent, collected at Perené, Rio Perené, Peru, by Carlos Schunke in 1921.

Paratypes. A.M.N.H. 23190, 23193, 23216, and 23232, with the same data as the type.

Diagnosis. Distinguished from all other subspecies by the presence of a horizontally divided loreal (fig. 3).

Description. The scalation of this subspecies is identical to that of *o. ocellata* except for the above mentioned diagnostic character. The nuchals are flat, quadrangular, and in a single transverse row. The last pair of postmentals is separated from the lower labials in all the specimens examined except one (A.M.N.H. 56489). In this specimen the last pair of postmentals is exceptionally large.

The scale counts for the type and paratypes are: Midbody 26–28; transverse dorsal rows 32; transverse ventral rows 20; gulars 7–10. The counts for all of the specimens examined, including the type and paratypes, are tabulated at the beginning of this section.

Color. The specimens examined show considerable variation in color pattern. The type and paratypes are an overall dark olive-gray. The type and some of the paratypes have a darker vertebral stripe with only a faint indication of dorsolateral white stripes. The type is a male and has 3 ocelli on each side, one above the forelimb and one anterior and another posterior to the forelimb. Light paravertebral stripes are not present on any of the types. However, dark vertebral stripes and faint dorsolateral stripes may or may not be present. The postmentals are spotless, the gulars may have a few black dots, while the ventrals and subcaudals have the central portion of each scale heavily pigmented.

Three of the other specimens examined are melanistic (A.M.N.H. 56300–02, ♀♀). The dorsal and lateral surfaces are black without any indication of lighter markings. Ventrally the outer rows of abdominal scales are very heavily pigmented, while the medial rows, though not as heavily pigmented, are still darker than in other specimens. The gulars in one of these specimens are spotless. In the others they are moderately flecked. The postmentals are only pigmented on their lateral surfaces where they come in contact with the darkly pigmented lower labials.

The light dorsolateral and paravertebral stripes that are typical of *o. ocellata,* are present on all the other specimens examined. The paravertebral stripes, however, may be ill-defined and confluent with the surrounding darker pigment. The ventrals in these specimens are centrally pigmented or spotless. Some of the males have about 10 well-marked ocelli on the side of the body. One specimen (A.M.N.H. 56275), a female, has about 10 very faint ocelli on each side of the body.

A total of 6 juveniles (snout to vent length of 30 mm. or less) were examined. All showed well marked dorsolateral and paravertebral light stripes. Large white blotches, instead of ocelli, were present on the sides of the body of some of the juveniles.

Remarks. Of the 21 specimens examined, 16 had 2 preanal scales and the rest had either 3 or 4 preanals. There were from 3/3 to 5/5 femoral pores. There was no sexual dimorphism in respect to these 2 characters. There were from 1 to 5 palpebrals, only a single specimen having 1 palpebral.

One specimen (A.M.N.H. 23190) has three prefrontals, rather than the normal two.

Specimens examined. PERU: Uchpayacu, upper Rio Cushabatay, Rio Ucayali system, A.M.N.H. 56489; Lower Rio Cushabatay, A.M.N.H. 56300; Pampa Hermosa, near mouth of Rio Cushabatay, A.M.N.H. 56275, 56290; Pachisa, valley of Rio Huayabamba, Rio Huallaga system, A.M.N.H. 56273–74, 56288; Bombo, Rio Tapiche Valley, A.M.N.H. 56271–72, 56287, 56301–02; Chanchamayo, Dept. Junin, A.M.N.H. 56289, 56391; Perené, Rio Perené, Dept. Junin, A.M.N.H. 23191 (type), 23190, 23193, 23216, 23232 (paratypes). BOLIVIA: Tumupasa, A.M.N.H. 22530–31.

Genus ALOPOGLOSSUS Boulenger

Alopoglossus Boulenger, 1885, Cat. Liz. Brit. Mus., vol. 2, p. 383.

The species of this genus have been in greater taxonomic confusion than any of the species so far studied. The classification that is proposed here undoubtedly is neither final nor perfect. However, it is believed that the taxonomic position of the species has been improved and when series of specimens become available the more rudimentary problems will already have been solved.

Alopoglossus is a lowland as well as a mountain form and as a result, there has probably been considerable subspeciation. However, due to the poor data that accompany the few specimens that are now available an analysis of this problem is impossible. *A. buckleyi*, as well as some of the other species defined here, is not a natural group. It represents a taxonomically expedient grouping, arrived at arbitrarily, but which should facilitate further studies.

Taylor (1949) described *Alopoglossus plicatus* from Costa Rica without reference to *Ptychoglossus*. With the aid of Taylor's careful description and an immature (24 mm. snout to vent length) specimen of *plicatus* from La Costilla, Costa Rica (A.N.S.P. 23753), it has become evident that Taylor's species is a *Ptychoglossus*, probably closely related to *Ptychoglossus festae* of Panama. Taylor's *plicatus* superficially approaches *Alopoglossus* more than any of the other species of *Ptychoglossus*. It is not, however, an annectent form. *Ptychoglossus*, in contrast to *Alopoglossus*, is characterized by much smaller dorsal scales, which have parallel sides and are in perfect transverse rows; by having the gulars quadrangular and subimbricate, and by having the ventrals rectangular or quadrangular, with the posterior borders truncate. The only species of *Alopoglossus* that may be confused with *Ptychoglossus* is *A. festae* of Ecuador. In this species the gular scales, though not pointed, as in most of the other species of *Alopoglossus*, are imbricate and the width of the posterior margin of the scales is less than the width of the base of the scales. The ventrals are also truncate, but have the same proportions as the gulars. The dorsals, furthermore, are markedly mucronate and with non-parallel borders. It may also be added that all species of *Alopoglossus* have keeled scales on the forelimbs whereas the species of *Ptychoglossus* all have smooth scales.

Alopoglossus gracilis Werner (1913) is not included in this study. The description is very poor and it is impossible to determine whether the generic allocation is correct. Very possibly *gracilis* represents a species of *Ptychoglossus*.

Generic definition. Tongue covered with oblique plicae. Single or divided frontonasal; prefrontals in contact medially; frontal; frontoparietals; interparietal equal in length to the parietals; no postparietals; nostril in a divided nasal; loreal small and separated from the upper labials by the nasal and frenoocular; supraoculars 4; superciliaries 4, the first without dorsal expansion; palpebrals 3–6; suboculars 3–4, the second 3 times the length of the first; upper labials 5–7; lower labials 5–6; first postmental single and followed by 3 pairs of postmentals. Dorsals large with well developed keels, mucronate, in diagonal and transverse rows. Laterals like the dorsals, unreduced. Ventrals with a pointed or truncate posterior border, keeled or smooth, and in longitudinal and transverse rows. Gulars pointed or truncate, keeled or smooth, and in diagonal and transverse rows or in 2 longitudinal rows. Caudals like the dorsals, subcaudals narrow and in longitudinal rows. Scales of the limbs keeled. Femoral and preanal pores may be present.

Key to the species of ALOPOGLOSSUS

1. Gulars transversely enlarged and arranged in 2 longitudinal rows; 3 preanal scales; range: Pacific side of Ecuador........................*festae*
   Gulars not arranged in 2 longitudinal rows; 4 preanal scales...........2
2. Scales on the side of the neck large and conical; scales on the posterior half of the dorsum in longitudinal rows; range: eastern Ecuador......*copii*
   Not as above..3
3. Scales on the side of the neck small, almost granular; range: Ecuador and northeastern Peru..*buckleyi*
   Scales on the side of the neck keeled, imbricate, not granular..........4
4. Gulars keeled or smooth, pointed, not truncate; ventrals spotless; range: eastern Ecuador, eastern Peru, Brasil, and Guianas.....*carinicaudatus*
   Gulars smooth with a convex posterior border; ventrals with basal and lateral margins pigmented; range: Dept. Puno, Peru..*andeanus* sp. nov.

ALOPOGLOSSUS FESTAE Peracca

Alopoglossus festae Peracca, 1904, Boll. Mus. Zool. Univ. Torino, vol. 19, no. 465, p. 7.

Pantodactylus buckleyi buckleyi Burt and Burt, 1930, Proc. U. S. Nat. Mus., vol. 78, p. 35.

Pantodactylus buckleyi festae Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 359.

Type locality. Vinces, Ecuador.

Description. Frontonasal broader than long; prefrontals in contact medially; frontal hexagonal; frontoparietals elongate; parietals and interparietals equal in length, the anterior width of the interparietal being greater than its posterior width; first supraocular much smaller than the other 3 supraoculars; palpebrals 3–6; temporals keeled and irregular, the 2 upper temporals larger than the rest; upper labials 7, the third the largest; lower labials 5–6; the last pair of postmentals are in contact medially in all the specimens examined except one (U.S.N.M. 20613); no well developed pregulars.

Dorsals longer than exposed width, keeled, imbricate, mucronate, and in transverse and diagonal rows. Ventrals smooth, truncate, in longitudinal and transverse rows. Gulars transversely enlarged and arranged in 2 longitudinal rows. Scales on the side of the neck small,

SUMMARY OF DATA FOR SPECIES OF *ALOPOGLOSSUS*

(Mean value of scale counts is in parentheses below extreme values)

				SCALE COUNTS			
Species	No. of Specimens	Sex Ratio ♂/♀	Maximum Snout to Vent Length (mm.)	Midbody	Transverse Dorsal Rows	Transverse Ventral Rows	Gulars
festae	11	1/10	59	23–28 (25.6)	30–31 (30.4)	18–22 (19.7)	6–8
buckleyi	11	7/4	50	24–28 (25.7)	28–33 (30.4)	16–21 (19.1)	7–8
carinicaudatus	4	2/2	54	19–22	27–30	16–21	6–8
copii	2	1/1	52	20	23–25	20	8
andeanus	1	1/0	58	20	28	17	8

convex, nonimbricate, smooth or faintly keeled. Scales of the fore and hind limbs keeled except for the ventral surface of the hind limbs. There are 3 preanal scales, the median scale being twice as large as the laterals. Caudals and subcaudals in longitudinal rows; the subcaudals are narrower than the caudals and keeled except for the proximal portion of the tail. The distal digital lamellae are double while the proximal lamellae are single. The lamellae of the toes are double. Females have no pores or may have up to 2/2 pores. The pores may be actually preanal or femoral. The single male examined had 7/8 pores, the more proximal pores being preanal in position.

Scale counts. Midbody, 23–28; transverse dorsal rows, 30–31; transverse ventral rows, 18–22; gulars, 6–8.

Color. There is no sexual dimorphism in pattern. The dorsal surface of the head and body is very dark brown or black. In a single specimen a hardly distinguishable blue vertebral stripe was evident. With the exception of this single specimen all others were characterized by the unbroken coloration of the dorsum. The outer row of ventrals is moderately pigmented while the median rows are spotless. The gulars and postmentals may be spotted with black or spotless. The subcaudals are spotless.

Remarks. I have examined the specimens that lead Burt and Burt to claim hybridization between *festae* and *buckleyi*, and have not found any evidence for this opinion. Burt and Burt limited themselves to distinguishing *festae* and *buckleyi* by a single character — the third pair of postmentals in contact medially (*festae*) or separated (*buckleyi*). Actually only one specimen of *festae* has the third pair of postmentals separated medially; this is U.S.N.M. 20613 from Playa de Oro, Rio Santiago, Esmeralda Prov., in the northwestern coastal plain of Ecuador. This locality is actually far from the known range of *buckleyi*. These two species may be distinguished by the following characters:

buckleyi	*festae*
1. Four preanal scales.	1. Three preanal scales.
2. Gulars not in 2 longitudinal rows.	2. Two longitudinal rows of transversely enlarged gulars.
3. Brown dorsum with darker vertebral spots.	3. Black or very dark-brown dorsum without darker vertebral spots.

It is not claimed that hybridization does not occur between *festae* and *buckleyi* but rather that there is no evidence for this at present.

Parker (1934) gives a brief description of 3 specimens from Zamora, Ecuador, which he believes to represent *A. buckleyi festae.* He apparently had no specimens of true *festae* for comparison at the time.

J. C. Battersby of the British Museum kindly examined the specimens for me. From his data and Parker's description, it is evident that the specimens differ more from *festae* than they do from *buckleyi*. Parker observed sexual dichromatism in these specimens, which is a typical character of *buckleyi* and not of *festae*. Battersby informs me that the color pattern is of dark-brown vertebral spots, with the sides of the body darker than the ground color of the dorsum. This is also typical of *buckleyi*. Two of the specimens have the third postmentals in contact medially, the other specimen has them separated. The specimens further differ from *buckleyi* in that the gulars are flat, smooth, and wider than long. However, the gulars are not in 2 longitudinal rows as in *festae*. These specimens may well represent a subspecies of *buckleyi*, but evidently not of *festae*.

All of the specimens examined are from the coastal plain of Ecuador and all localities are below an altitude of 600 meters. It is interesting to note that *festae* is the only species of the four genera studied that is found on the Pacific coast of South America.

Specimens examined. ECUADOR: Playa de Oro, Rio Santiago, Esmeralda Prov., U.S.N.M. 34867; Santa Elena, A.M.N.H. 21855; Naranjal, A.M.N.H. 23429; Pasaje, Rio El Rompido, A.M.N.H. 21856, M.C.Z. 34867; Ventura, Rio Chanchan, A.M.N.H. 23038–39; Bucay, Rio Chimbo, A.M.N.H. 21956; Puente de Chimbo, near Bucay, A.M.N.H. 24342; Santa Rosa, Rio Santa Rosa, A.M.N.H. 21995; Piñas, north of Alamor, A.M.N.H. 22217.

ALOPOGLOSSUS COPII Boulenger

Alopoglossus copii Boulenger, 1885, Cat. Liz. Brit. Mus., p. 383.
Pantodactylus copii Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 357.

Type locality. Pallatanga and Canelos, Ecuador.

Description. This species is similar to *carinicaudatus* and is characterized by the following: The dorsal scales are very broad, keeled and mucronate; some scales broader than long. The dorsals on the posterior half of the dorsum are in longitudinal rows. At the midline, especially at the base of the tail, small scales are interspersed between the paravertebral rows of dorsals. The lateral scales are not as wide as the dorsal. Ventrals pointed and with a flat keel. The scales on the side of the neck are large and conical. A slightly enlarged pregular is present on the medio-posterior border of each of the last postmentals. Gulars triangular and with a flat keel. From the specimens examined it appears that the distal lamellae of the toes tend to be single. There are 14/14 femoral pores and 4 preanal pores in the male, and 0/0 and no preanals in the female.

Scale counts. Midbody, 20; transverse dorsal rows, 23 and 25; transverse ventral rows, 20; gulars, 8.

Color. No evident sexual dimorphism. The dorsum is brown with darker irregular vertebral spots and some white dorsolateral scales. The lowermost scale rows of the sides are lighter than the dorsals. The top of the head is light-brown with dark spots on the prefrontal suture and posterior edge of the parietals. There are 2 white spots above the forelimb on both specimens. The mentals and pregulars have large dark-brown blotches. All gulars and ventrals are lightly flecked with brown on the anterior portion of the scale. The preanals and subcaudals are more heavily pigmented.

Remarks. Little can be said about the variation or range of this species. Boulenger's specimens came from Pallatanga and Canelos, and the two specimens examined are from eastern Ecuador. Although this species appears to be closely related to *carinicaudatus*, it cannot be determined whether they overlap in distribution or are full species or subspecies, due to the scarcity of specimens.

Specimens examined. ECUADOR: Rio Cotopino, Oriente, U.M.M.Z. 90776; Pastaza River, M.C.Z. 37267.

ALOPOGLOSSUS BUCKLEYI (O'Shaughnessy)

Leposoma buckleyi O'Shaughnessy, 1881, Proc. Zool. Soc. London, p. 233.
Alopoglossus buckleyi Boulenger, 1885, Cat. Liz. Brit. Mus., p. 385.
Pantodactylus buckleyi buckleyi Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 385.

Type locality. Canelos, Ecuador.

Description. Frontonasal about twice as broad as it is long; in 2 of the 10 specimens examined (M.C.Z. 45781 and A.M.N.H. 56263) the frontonasal is longitudinally divided, rather than single. The prefrontals have a short medial contact; frontal hexagonal; frontoparietals elongate; interparietal equal in length to the parietals; with broad longitudinal striation, especially marked on parietal and interparietal of males, in the females these scales may be smooth; nostril is in a divided nasal; 3 suboculars, the second 3 times the length of the other 2; temporals are small and irregular, keeled in the males and smooth or faintly keeled in the females; about 7 upper labials, the third the longest; 6 lower labials; first postmental single and followed by 2 pairs of postmentals in contact medially; the third pair of postmentals are usually not in contact with the labials and are separated medially by small scales. Smaller, flat, pregular scales border the last pair of postmentals posteriorly. Dorsals are longer than wide, keeled, imbricate, mucronate and in diagonal and transverse rows. The lateral scales are blunter than the dorsals. Scales on the side of the neck are small and almost granular. Ventrals are in transverse and longitudinal rows, either smooth and pointed, rounded, or truncate posteriorly, or keeled and pointed posteriorly. Only a single male, A.M.N.H. 56263, of the 6 males examined had smooth, though pointed ventrals. The gulars are pointed and smooth or keeled. There are 4 preanal scales, the 2 medial scales being the largest. The caudals and subcaudals are in longitudinal rows; the subcaudals much narrower than the caudals. Scales of the dorsal and posterior surfaces of the fore and hind limbs keeled, those of the ventral surface smooth. Lamellae of the digits single except for the most distal lamellae, which are usually double. The lamellae of the toes are double. Males with 9/9 to 14/14 femoral pores and without or with 2 to 4 preanal pores. Females without preanal or femoral pores.

Scale counts. Midbody, 24–28; transverse dorsal rows, 28–33; transverse ventral rows, 16–21; gulars, 7–8.

Color. Overall color dark to light-brown. Head usually lighter than the body. Males with irregular dark brown vertebral blotches and with the lateral surface of the body a very dark-brown or black. Some of the lowermost lateral scales are white. Side of the neck dark, like the side of the body and with white scales dispersed or forming a white line from the lower labials along the lower border of the ear and ending above the forelimb. Dark vertebral spots are present on the females; however, the lateral surfaces are only slightly darker than the dorsum. At the base of the tail, in both sexes, a dark vertebral band is present with a white blotch on the dorsolateral edges. This same marking may be repeated on the tail. Ventrally the males are heavily pigmented, the anterior portion of each scale dark-brown while the rest of the scale is white. This same type of pigmentation may or may not be present on the gular region. The mentals are likewise either totally, partially, or not at all pigmented. The subcaudals tend to be alternately darkly pigmented and lightly pigmented so as to form regular bands of light and dark scales. In the females the ventral surface is colorless except for spotting on the preanals and subcaudals.

Remarks. The variation present in this form is considerable. The problem of subspeciation is in this case made more difficult by the fact that *buckleyi* is present on both the Pacific and Amazon sides of the Andes.

Specimens examined. ECUADOR: San Jose de Sumaco, A.M.N.H. 28898; Naranjal, A.M.N.H. 32777; between Rio Pastaza and Rio Santiago, C.M.N.H. 42508–09, Santiago-Zamora Prov., M.C.Z. 45781; Alpa Yacu, U.M.M.Z. 90774; Rio Pastaza, Oriente Prov., U.M.M.Z.

90775; Ecuador, M.C.Z. 25916. PERU: Mouth of Rio Santiago, Rio Marañon Valley, A.M.N.H. 56263, 65276; Peru-Brasil, Utoquinia-Tapiche, A.M.N.H. 56279.

ALOPOGLOSSUS CARINICAUDATUS (Cope)

Leposoma carinicaudatum Cope, 1876, Jour. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 8, p. 160.

Alopoglossus carinicaudatus Boulenger, 1885, Cat. Liz. Brit. Mus., p. 384.

Alopoglossus amazonius Ruthven, 1924, Occas. Papers Mus. Zool. Univ. Michigan, no. 153, p. 1.

Pantodactylus carinicaudatus Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 358.

Alopoglossus copii surinamensis Brongersma, 1946, Zool. Mededeel., Leyden, vol. 26, p. 231.

Type locality. Valley of Rio Marañon, Peru.

Description. Frontonasal single and broader than long; prefrontals with a short medial contact, or separated by a posterior extension of the frontonasal; frontal hexagonal; prefrontals elongate; interparietal as long as the parietal; nostril in a divided nasal; 3 suboculars, the second three times the length of the first; temporals small, irregular and keeled, the two larger upper temporals bordering the parietal; about 7 upper labials and 6 lower labials; the third pair of postmentals in contact medially only at their anteriormost point in a single specimen, the other specimens having the third pair of postmentals separated by a single row of small scales. This last pair of postmentals are also separated from the lower labials by a small scale. No definite large pregulars bordering this last pair of mentals posteriorly as in *buckleyi*. Dorsals are keeled, imbricate, mucronate, in transverse and diagonal rows and much broader than in *buckleyi*. The width of the dorsals is nearly as great as their length. The mucro is slightly reduced on the lateral scale. Ventrals are smooth or with a broad, flat keel, pointed and in longitudinal and transverse rows. Gulars are in diagonal and transverse rows, keeled and mucronate. However, the medial gulars may merely be pointed and without a keel. The scales on the side of the neck are keeled, imbricate and mucronate, but smaller and of the same shape as the dorsals. Preanals composed of two large medial scales and a smaller lateral scale on each side. The preanals may have a dull keel. Caudals and subcaudals keeled, mucronate and in longitudinal rows. Scales of the fore and hind limb keeled, except for those of the ventral surface of the hind limbs. Digital lamellae single, though the more distal lamellae may be paired. Lamellae of the toes double. Males with 10/10 femoral pores and two preanal pores. Females without femoral or preanal pores.

Scale counts. Midbody, 19–22, transverse dorsal rows, 27–30; transverse ventral rows, 16–21; gulars, 6–8.

Color. Overall color dark or light-brown. Irregular dark vertebral splotches present. Irregular dorsal lateral light spots are faintly evident. There is no evident sexual dichromatism. The lateral surfaces of the body are slightly darker than dorsal. The entire ventral surface is spotless, except for spotting on the preanals and irregular blotches on the subcaudals. The dorsal surface of the head is yellow-brown. The spot on the preanals is located on the lateroposterior edge of the median preanals.

Remarks. Ruthven's *amazonius,* though from a more southern locality (Villa Murtinho, Brasil) than any of the specimens examined, appears to be similar to *carinicaudatus.* The smooth, though pointed, gulars that Ruthven attributes to his species are also found in the more northern examples of *carinicaudatus.*

It is to be expected, from the evidence in other teiid genera, that species extending from the upper Amazon to the Guianas should subspeciate. However, the single available specimen of *carinicaudatus* from British Guiana is identical with the Peruvian specimens. *A. copii surinamensis* described by Brongersma is actually a specimen of *carinicaudatus.* The description compares very well with the British Guiana and Peruvian examples of *carinicaudatus.* Brongersma used the proportion of snout-to-vent length to length of hind limb to differentiate his species. Below are the tabulations of the measurements for the specimens examined of *copii* and *carinicaudatus,* as well as those for the types of *carinicaudatus, copii surinamensis,* and the type and one of the paratypes of *copii.*

	A Snout to Vent Length (mm.)	B Length of Hind Limb (mm.)	A/B Ratio
carinicaudatus			
A.M.N.H. 61381 ♀	54	24	2.25
A.M.N.H. 56278 ♀	52	21	2.47
A.M.N.H. 56277 ♂	41	19	2.16
U.M.M.Z. 84737 ♂	37	17	2.18
TYPE ♂	50	23	2.18
copii surinamensis			
TYPE ♀ (?)	29	13.5	2.14
copii			
M.C.Z. 37267 ♀	55	30	1.83
U.M.M.Z. 90776 ♂	52	27	1.93
TYPE ♂	56	30	1.86
PARATYPE ♀	74	37	2.00

The number of specimens examined is probably not a statistically adequate sample. However, *copii surinamensis* is closer to the lower figures of the *carinicaudatus* males than to those of *copii.*

Specimens examined. BRITISH GUIANA: Marudi, A.M.N.H. 61381. ECUADOR: San Francisco, Rio Napo, U.M.M.Z. 84737. PERU: Iquitos, A.M.N.H. 56277; Rian-Rian, Rio Subumaya, Contamana Region, A.M.N.H. 56278.

ALOPOGLOSSUS ANDEANUS sp. nov.

Type. M.C.Z. 45590, an adult male, collected at La Pampa, Dept. of Puno, Peru, at an altitude of 760 meters (2,500 feet) by G. P. Gardner, on January 23, 1940. Snout to vent length 58 mm.

Diagnosis. Related to *carinicaudatus* but distinguished from this species by the dark-brown pigmentation of the ventrals, gulars, and mental region. Also distinguished from *carinicaudatus* by having smooth, posteriorly rounded median gulars and ventrals. It is distinguished from the other species of *Alopoglossus* by the presence of keeled, imbricate and mucronate scales on the side of the neck.

Description. Frontonasal nearly twice as broad as long; prefrontals in contact medially; frontal hexagonal; frontoparietals elongate; interparietal as long, but narrower than the parietals. The parietals and the interparietal each have 2 longitudinal ridges. Nostril in a divided nasal; loreal small and separated from the labials by the frenoocular; supraoculars 4, the second and third larger than the first and fourth; superciliaries 4; palpebrals 3; suboculars 3, the second 3 times the length of the first; 2 upper temporals bordering the parietal and each bearing a blunt ridge; the rest of the temporals smaller, keeled and irregular; upper labials 7, the third the largest; lower labials 6. The first postmental is single and is followed by 2 pairs of postmentals in contact medially; the third pair of postmentals are separated medially by a single row of 2 scales and are separated from the lower labials by an elongate scale. A slightly enlarged pregular is present on the medio-posterior border of each of the third postmentals. Dorsals longer than wide, keeled, imbricate, mucronate and in transverse and diagonal rows. Laterals like the dorsals. Ventrals smooth with a rounded posterior border and in longitudinal and transverse rows. Gulars smooth, pointed, except for the median gulars that have a convex border, in diagonal and transverse rows. Scales on the side of the neck keeled, imbricate, mucronate and smaller than the dorsals. A large pair of median preanals with a smaller lateral scale on each side. Scales of the fore and hind limbs keeled, except for the ventral surface of the hind limbs. Caudals and subcaudals in longitudinal rows, the subcaudals narrower than the caudals. Femoral pores 10/10 and 4 preanal pores, 2 preanal pores on each side, at the junction of the limb with the body. Distal digital lamellae double, the rest single. The lamellae of the toes double.

Scale counts. Midbody, 20; transverse dorsal rows, 28; transverse ventral rows, 17; gulars, 8.

Color. The top of the head is light-brown; the posterior edge of the parietals and interparietals is darker. The dorsum is mahogany-brown with a lighter dorsolateral region. The lateral surfaces are darker than the dorsum; however, the lowermost lateral scales are white-tipped. A white stripe extends from the angle of the mouth and ends anterior to the forelimb. The mentals are blotched with very dark-brown. The gulars and ventrals are dark-brown on the anterior and lateral portions; the rest of the scale is spotless. The lateroposterior border of the median preanals is dark-brown and a brown spot is present on the posterior end of the common median edges. The subcaudals have irregular brown blotches.

Remarks. The differences between this species and *carinicaudatus* have already been pointed out in the above diagnosis. *Alopoglossus andeanus* may be confused with Parker's specimens of *buckleyi* from Zamora, Ecuador, which have been referred to under the discussion of *festae*. However, Parker's specimens have dark vertebral spots, and J. C. Battersby kindly informed me that the scales on the side of the neck are granular. In contrast, *andeanus* is characterized by the absence of dark vertebral spots and in having large keeled and imbricate scales on the side of the neck.

Genus PANTODACTYLUS Duméril and Bibron

Pantodactylus Duméril and Bibron, 1839, Erp. Gen., vol. 5, p. 428 (*P. dorbignyi* Duméril and Bibron = *Cercosaura schreibersii* Wiegmann).

Burt and Burt (1931, p. 357) included in the genus *Pantodactylus* the genera *Loxopholis* Cope and *Alopoglossus* Boulenger. The first has been shown in this paper to be synonymous with *Leposoma*. *Alopoglossus* was considered by Burt and Burt to be synonymous with *Pantodactylus* because the obliquely plicated lingual papillae, diagnostic of *Alopoglossus*, were found by Peracca (1894) and the Burts on the posterior bifurcation of the tongue of *P. schreibersii*. Actually most teiids that have imbricate scale-like papillae on the tongue may have the posterior bifurcation covered with oblique plicae. In *Alopoglossus* the entire tongue is covered with oblique plicae without any evidence of scale-like papillae. In *Pantodactylus* the oblique plicae, when present, are always restricted to the posterior portion of the tongue. This fact together with the many differences in scalation between the genera, is more than sufficient evidence for considering the two genera distinct.

Two species listed under *Pantodactylus* in the check list of South American lizards (Burt and Burt 1933) are not considered as such here. *Pantodactylus nicefori* Burt and Burt has been previously shown to be a lacertid (Ruibal, 1950). The other species, *Pantodactylus tyleri* Burt and Burt, actually represents a species of *Arthrosaura*. This is based on the fact that *tyleri* is like the other species of *Arthrosaura* (with the exception of *A. tatei*) and unlike *Pantodactylus* in that the subcaudals are elongate, narrow and with a convex posterior border; the first supraciliary does not expand dorsally; the parietals and interparietals are equal in length; and there is a line of demarcation between the lateral scales and the ventrals. *Arthrosaura tyleri* appears to be related to *A. kockii*.

All the species of *Pantodactylus* are lowland forms, none of the specimens examined having been collected above 600 meters.

Generic definition. Tongue anteriorly covered with imbricate scale-like papillae. Head scales smooth and consisting of the following: Single frontonasal; prefrontals; frontal; frontoparietals; an interparietal that is longer than the parietals; postparietals, median occipital and in some cases nuchals; nostril in a divided or single nasal; loreal large (fig. 4); triangular frenoocular; supraoculars 3; first superciliary large and expanded dorsally; single transparent palpebral; upper labials 6–7; lower labials 5–6; first postmental single and followed by 4 pairs of postmentals; temporals smooth, upper larger than the lower. The dorsals are elongate, pointed, hexagonal or lanceolate (fig. 5), keeled, and in diagonal and transverse rows. The laterals are like the dorsals or slightly reduced. The scales on the side of the neck are granular. Ventrals smooth, quadrate, imbricate or subimbricate; the posterior border may be truncate or slightly convex and in longitudinal and transverse rows. Caudals like the dorsals and in transverse and diagonal rows. Subcaudals like the ventrals and in 2 or 4 longitudinal rows. Males with femoral pores, females may or may not have femoral pores. No preanal pores.

Key to the species of PANTODACTYLUS

1. Males with less than 8/8 femoral pores; 2 preanal scales..............2
   Males with 8/8 or more femoral pores; 3 preanal scales; range: States of São Paulo, Minas Geraes and Rio de Janeiro, Brasil.....*quadrilineatus*
2. Lateral white stripe originating below the eye, passing through the lower half of the ear, and above the forelimb..........................3

No lateral white stripe; overall color gray or black and usually with a dorsolateral white stripe; range: northern Argentina, Uruguay, Paraguay and southern Brasil . . . . *schreibersii schreibersii*

3. Some of the dorsals black-tipped and arranged to form irregular vertebral and paravertebral longitudinal stripes; females with 0/0 or 1/1 femoral pores; range: southcentral Brasil (Minas Geraes and Matto Grosso) . . . *schreibersii albostrigatus*

Color pattern not as above; females with 2/2 or 3/3 femoral pores; range: Bolivia . . . . *schreibersii parkeri* subsp. nov.

PANTODACTYLUS QUADRILINEATUS Boettger

Cercosaura (*Pantodactylus*) *quadrilineata* Boettger, 1876, Ber. Senckenb. Ges., p. 141.

Prionodactylus quadrilineatus Boulenger, 1885, Cat. Liz. Brit. Mus., vol. 2, p. 393.

Euspondylus quadrilineatus Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 333.

Pantodactylus femoralis Vanzolini, 1948, Papeis Avulsos Dept. Zool. Sec. Agric. São Paulo, vol. 8, p. 337.

Type locality. São Paulo, Brasil.

Description. Frontonasal broader than long; prefrontals in broad contact medially; frontal hexagonal; interparietal longer and narrower than the parietals; postparietals and a median occipital; a pair of very large nuchals; nostril in a divided nasal; loreal large and in contact with the upper labials; superciliaries 3; single transparent palpebral; suboculars 4; first postmental single, first 2 pairs of postmentals in contact medially, the last 2 pairs separated medially.

Dorsals lanceolate; laterals like the dorsals but wider; scales on the side of the neck smooth and granular; ventrals truncate, the 2 median rows wider than the outer rows. There are 3 preanal scales, a median and 2 laterals. Scales of the forelimbs smooth, those of the hind limbs also smooth but for the tibials which are keeled. The specimen is a male and has 8/9 femoral pores.

Scale counts. Midbody, 26; transverse dorsal rows, 28; transverse ventral rows, 21; gulars, 8.

Color. Dorsally the specimen is a uniform brown-gray, without any evidence of stripes. The mental and gular regions are moderately flecked with brown. The abdominal and subcaudal surfaces are moderately spotted with brown.

Remarks. Boettger originally described *quadrilineatus* and placed it in the subgenus *Pantodactylus*. Boulenger (1885), disregarding Boettger's allocation, placed *quadrilineatus* in *Prionodactylus*. Actually

SUMMARY OF DATA FOR SPECIES OF *PANTODACTYLUS*

(Mean value of scale counts is in parentheses below extreme values)

				SCALE COUNTS			
Species	No. of Specimens	Sex Ratio ♂/♀	Maximum Snout to Vent Length (mm.)	Midbody	Transverse Dorsal Rows	Transverse Ventral Rows	Gulars
s. schreibersii	22	7/15	53	23–27 (25.2)	30–36 (32.4)	19–26 (22.1)	7–8
s. albostrigatus	3	0/3	39	25–26	31–32	19–20	7–8
s. parkeri	43	19/25	48	24–29 (26.5)	29–35 (32.4)	18–22 (19.9)	7–8
quadrilineatus	1	1/0	37	26	28	21	8

this species is distinct from *Prionodactylus* in having lanceolate, rather than hexagonal, dorsals and unreduced lateral scales.

A careful comparison of the single specimen examined with the description of the type reveals that it corresponds perfectly in scalation, but not color. Boettger described *quadrilineatus* as having 4 longitudinal white stripes, a lateral pair and what may be interpreted to be a pair of dorsolateral stripes. This character led Burt and Burt to include *albostrigatus* in the synonymy of *quadrilineatus*. Actually the differences in scalation between these species outweigh their apparent similarity in color pattern. The specimen examined was collected in 1865 and whether the lack of longitudinal stripes is the result of age, or of its representing a new subspecies, or dichromatism in the species, is impossible to say.

P. E. Vanzolini agrees with the author in regarding *femoralis* as synonymous with *quadrilineatus*.

Specimen examined. BRASIL: Rio de Janeiro, M.C.Z. 4326.

PANTODACTYLUS SCHREIBERSII SCHREIBERSII (Wiegmann)

Cercosaura schreibersii Wiegmann, 1834, Herpet. Mexicana, p. 10.
Pantodactylus dorbignyi Duméril and Bibron, 1839, Erept. Gen., vol. 5, p. 431.
Pantodactylus bivittatus Cope, 1863, Proc. Acad. Nat. Sci., Philadelphia, p. 103.
Pantodactylus schreibersii Boulenger, 1885, Cat. Liz. Brit. Mus., vol. 2, p. 388.
Pantodactylus borelli Peracca, 1894, Boll. Mus. Zool. Univ. Torino, vol. 9, no. 176, p. 1.

Type locality. Brasil.

Description. Frontonasal about as long as its maximum width; prefrontals in contact medially; frontal hexagonal, pentagonal in a few cases in which the posterior border is truncate; frontoparietals elongate and larger than the prefrontals; interparietal longer but narrower than the parietals; pair of postparietals, usually separated medially by a small occipital; a single transverse row of irregular flattened nuchals, not as large as in *quadrilineatus*; supraoculars 3; superciliaries usually 3, occasionally 4; suboculars 3–4; nostril in a divided or inferiorly grooved nasal; loreal large and usually in contact with the upper labials; the last 2 pairs of postmentals are widely separated medially by the pregulars; pregulars bordering the postmentals larger than the median pregulars.

Dorsals lanceolate (fig. 5), occasionally subhexagonal. Laterals like the dorsals but slightly wider. Ventrals truncate or lightly convex. There are 2 large preanal scales; occasionally a very small lateral scale may be present on each side. Males with 3/3–5/6 femoral pores, females with 1/1–2/3 femoral pores.

Scale counts. Midbody, 23–37; transverse dorsal rows, 30–36; transverse ventral rows, 19–26; gulars, 7–8.

Color. The specimens examined show dichromatism in this subspecies. About 40 per cent of the specimens are gray with a white stripe extending from each temporal region, passing above the ear and forelimb, dorsolaterally along the body and onto the tail. This stripe may be very distinct or faint. The dorsal surface of the head is gray and with a few black spots. Ventrally there is a dustlike flecking on each ventral. The rest of the specimens examined are melanistic, black or very dark gray-black, with the dorsolateral stripe faintly indicated or absent. Ventrally they are flecked with black or gray. In both forms each subcaudal has the central portion heavily pigmented.

Remarks. Of the 22 specimens examined 2 had the loreal separated from the labials by a forward extension of the frenoocular. Both these specimens (D.Z. 786, 789A) are from the northern range of this subspecies; however, they do not resemble *albostrigatus* in any other character.

One specimen (A.M.N.H. 17022) from Salta, Argentina, has a faint lateral white stripe from the lower half of the ear and along the neck. This specimen may thus be considered to be intermediate between *schreibersii* and *parkeri*. It is here considered as *schreibersii* because it is gray in color and has lanceolate dorsals, both of which are characters found in *schreibersii* and not in *parkeri*.

The only sexual dimorphism observed is in the case of femoral pores. One female had 1/1 femoral pores, another had 2/3, while all the rest had 2/2. The males have 3/3 or 4/4 with the exception of a single specimen that has 5/6 (A.N.S.P. 12954).

In a few of the gray specimens the black-tipped dorsals typical of *albostrigatus* are present. However, there are few black-tipped scales and never arranged as in *albostrigatus*.

In a well preserved specimen from São Paulo (D.Z. 1893) a series of ocellus-like white scales are present on the side of the body.

Pantodactylus borelli Peracca is included in the synonymy of *schreibersii* with some doubt. From the description *borelli* is identical to *schreibersii* in scalation. However, Peracca describes his specimen as having 5 longitudinal stripes on the dorsum. It is possible, but at present not demonstrable, that Peracca's specimen is an intergrade of *schreibersii* and *albostrigatus*.

This subspecies appears to be a widespread and common form of northern Argentina, Uruguay, Paraguay, and southernmost Brasil.

Specimens examined. BRASIL: Santa Maria, Rio Grande du Sul, M.C.Z. 43350; São Joao de Rio Negro, São Paulo, A.N.S.P. 12954–55; Ipiranga, São Paulo, D.Z. 1893, 527, 789A; Campo Grande, Matto

Grosso, D.Z. 786; Itaqui, Rio Grande du Sul, D.Z. 684 (2 specimens); Porto Alegre, Rio Grande du Sul, D.Z. 1956. URUGUAY: Near Melo, Dept. Cerro Largo, C.N.H.M. 12343; Montevideo, M.C.Z. 22155–56, U.S.N.M. 38112–13, 68034. ARGENTINA: Buenos Aires, A.M.N.H. 65208, U.M.M.Z. 94090 (2 specimens); Salta, A.M.N.H. 17022; Cordoba, U.S.N.M. 52599.

PANTODACTYLUS SCHREIBERSII ALBOSTRIGATUS (Griffin)

Prionodactylus albostrigatus Griffin, 1917, Ann. Carnegie Mus., vol. 11, p. 314.
Euspondylus quadrilineatus Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 335.

Type locality. Sete Lagoas, State of Minas Gerais, Brasil.

Description. Similar in scalation to *s. schreibersii* except for the following: the dorsal scales are definitely hexagonal and the lateral scales are slightly smaller than the dorsals. The 3 specimens examined are females, the type of *albostrigatus* having 0/0 femoral pores while the other 2 specimens have 1/1. In the type both loreals are in contact with the labials, in another specimen only one loreal is in contact, while in the third specimen both loreals are separated by the frenoocular from the labials.

Scale counts. Midbody, 25–26; transverse dorsal rows, 31–32; transverse ventral rows, 19–20; gulars, 7–8.

Color. This subspecies is distinguished by having black-tipped dorsals that form irregular vertebral and paravertebral stripes. The scales between the stripes are white-tipped or lack a black tip. The width of the black stripes may be 1 or 2 scales, the scales lying next to each other having the black-tipped portions contiguous.

A white stripe originates below each eye, passes through the lower half of the ear, above the forelimb, and along the side of the body. The stripe may be faintly indicated on the side of the tail. The dorsolateral white stripe typical of *s. schreibersii* is indicated in this subspecies by a series of white-tipped scales extending from the ear to the tail.

One specimen has a slight dark flecking on each of the ventrals while the type and the other specimen have immaculate ventrals. An ocellus is present above the forelimb of the type.

Remarks. Burt and Burt considered *albostrigatus* identical to *quadrilineatus*. Actually *quadrilineatus* is distinguished from *albostrigatus* by the presence of 3 preanal scales rather than 2, a higher femoral pore count (this being an inference since no *albostrigatus* males, and no *quadrilineatus* females are known), an enlarged pair of nuchals, lanceolate dorsals, and fewer transverse dorsal rows. The possibility that *albostrigatus* represents the females of *quadrilineatus* has been considered. However, the differences listed above are greater than those of sexual dimorphism in teiids.

Griffin's figure of the type of *albostrigatus*, accompanying the description, has the first postmental longitudinally divided. This is an error, the first postmental in the type is actually single.

In the 3 specimens of *albostrigatus* examined the last pair of postmentals are separated from the lower labials by a small elongate scale. In *schreibersii* and *parkeri* this last pair of postmentals are in contact with the lower labials.

It is unfortunate that only 3 female specimens of this subspecies are available. These few specimens show considerable variation, and further collecting is necessary before the variations and geographic range can be definitely determined.

Specimens examined. BRASIL: Sete Lagoas, Minas Gerais, C.M. 952 (type); Chapada, N.E. of Cuyabá, Matto Grosso, A.N.S.P. 12956–57.

PANTODACTYLUS SCHREIBERSII PARKERI subsp. nov.

Pantodactylus schreibersii albostrigatus Parker, 1931, Linn. Soc. Jour. Zool., vol. 37, p. 286.

Pantodactylus schreibersii Burt and Burt (in part), 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 362.

Euspondylus champsonatus Burt and Burt (not Werner), 1931, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 335.

Parker (*supra cit.*) realized that the species Griffin had described as *Prionodactylus albostrigatus* was in reality a subspecies of *Pantodactylus schreibersii*. However, of the specimens that Parker had for examination, none was from near the state of Minas Geraes, Brasil, the type locality of *albostrigatus*. The specimens that Parker considered to be *albostrigatus* were all from Paraguay or Bolivia. When the large series of Bolivian specimens available to the present author were compared with the type of *albostrigatus*, it was evident that the Bolivian specimens did not represent *albostrigatus*. Therefore the author takes the pleasure of naming this new subspecies in honor of Dr. Parker.

Type. M.C.Z. 20627, collected at Buenavista, Dept. de Santa Cruz, Bolivia, by J. Steinbach in 1923. Snout to vent length, 38 mm.

Paratypes. M.C.Z. 20628–29; U.M.M.Z. 60595–96; A.M.N.H. 32776. All from the same locality as the type.

Diagnosis. Differs from *s. albostrigatus* in not having longitudinal rows of black-tipped dorsal scales and in the females having a higher femoral pore count. It differs from *s. schreibersii* in having a lateral white stripe that passes through the lower half of the ear and along the side of the body.

Description. Similar in scalation to *s. schreibersii* except for the following: dorsal scales definitely hexagonal; lateral scales equal in size to the dorsals or slightly reduced; in a few specimens the laterals are half the length of the dorsals. Nuchals more regular than in *s. schreibersii,* forming true nuchal plates, but never so large as in *quadrilineatus.* Females have from 2/2–3/3 femoral pores while the males have 3/3–5/5.

Scale counts. Midbody, 24–29; transverse dorsal rows, 29–35; transverse ventral rows, 18–22; gulars, 7–8.

Color. All of the 44 specimens examined were distinguished by having a white stripe originating below each eye, passing through the lower half of the ear, and above the forelimb. In a few specimens the stripe was not evident on the side of the body, while in some it continued along the side of the tail. This lateral stripe is bordered superiorly along all of its length by a dark-brown band. The dorsal surface of the body is of a lighter brown. In about 80 per cent of the specimens a dark vertebral stripe is present. This dark stripe may originate on the nuchal region and extend the entire length of the dorsum and onto the tail. Usually, however, this stripe is broken into an anterior nuchal stripe and a posterior sacral stripe, or the anterior stripe may be lost and only the sacral stripe remain. A few of the specimens show evidence of the dorsolateral white stripe typical of *s. schreibersii.* An irregular dark stripe extends from each upper labial to the neighboring lower labial. The mental region is cream-colored and spotless except for some of the scales bordering the posterior lower labials. The gulars are spotless or with a few dark flecks. The ventrals are likewise spotless; however, some of the posteriormost scales may have dark flecks. On well preserved specimens the abdomen is pink. In all the specimens the subcaudals are flecked with black.

Remarks. A single specimen (U.M.M.Z. 60598) has the black-tipped dorsals typical of *s. albostrigatus.* It is a female and has 2/2 femoral pores, unlike *s. albostrigatus.* The venter of this specimen is heavily pigmented in contrast to the other specimens of *s. parkeri.*

Three juvenile specimens (snout to vent length less than 30 mm.) were available and all had scale counts that fell within the variation observed in the adults and were similar in color.

The dorsal scales of this subspecies are definitely hexagonal, as in *s. albostrigatus,* in contrast to *s. schreibersii* which has lanceolate dorsals. The lateral scales are also hexagonal and the same size as the dorsals, slightly smaller, or as in 8 of the specimens, reduced to one-half the size of the dorsals.

Previously the only absolute distinguishing character between *Prionodactylus* and *Pantodactylus* was the presence of unreduced lateral scales in the latter and markedly reduced laterals in the former. No other character, or combination of characters, has been found to separate these two genera. Since *s. albostrigatus* and *s. parkeri* both have reduced lateral scales, it has become impossible to distinguish these genera in an absolute manner. It may be argued that both *s. parkeri* and *s. albostrigatus* represent examples of *Prionodactylus,* and that *s. schreibersii* and *quadrilineatus* constitute the genus *Pantodactylus* — both have lanceolate dorsals, a character not found in any species of *Prionodactylus.* The evidence for considering *parkeri* and *albostrigatus* subspecies of *schreibersii* is the possession of identical head scalation by the three forms and the almost identical scale counts. This is further supported by the single specimen of *s. schreibersii* from Salta, Argentina (A.M.N.H. 17022), which appears to represent an intergrade in that it has the lateral white stripe typical of *parkeri.* For the moment it appears best to leave *Prionodactylus* and *Pantodactylus* as separate genera, with the hope that further study will determine definitely the taxonomic position of the two genera.

One specimen examined has "Peru" as its locality. If *parkeri* is present in Peru it is probably restricted to the southeastern lowlands of Peru.

Specimens examined. Brasil: Villa Murtinho, State of Matto Grosso, U.M.M.Z. 56900; Peru: "Peru," C.N.H.M. 40018; Bolivia: Ixiamus, A.M.N.H. 22527; Rurrenabaque, A.M.N.H. 22528; Tumupasa, A.M.N.H. 22529; Buenavista, Dept. de Santa Cruz, M.C.Z. 20627 (type), 20628–29 (paratypes), 24886–88; A.M.N.H. 32776 (paratype); U.M.M.Z. 60613, 60624, 60625 (4 specimens), 60514 (5 specimens), 60595 (paratype), 60596 (paratype), 60597 (3 specimens), 69598 (2 specimens), 60599 (4 specimens), 63795, 63796 (4 specimens), 63797, 63798 (3 specimens), and 68089.

SUMMARY OF GENERIC DATA

Leposoma, Alopoglossus and *Cercosaura* primarily inhabit the northern half of South America. *Leposoma* is widespread, extending from Costa Rica and Panama to Colombia, eastern Ecuador, northeastern Peru, Venezuela, the Guianas and south to the state of Espirito Santo, Brasil. *Alopoglossus* has a more restricted range, extending from the coast of Ecuador to eastern Peru and the Guianas. The range of *Cercosaura* is very extensive; it ranges from the Guianas to eastern Peru, Bolivia and the state of Rio Grande du Sul, Brasil. In contrast, *Pantodactylus* has a strictly "southern" distribution being present in northern Argentina, Uruguay, Paraguay, southern Brasil, Bolivia and possibly in southeastern Peru. *Leposoma* and *Alopoglossus* show a more predominantly northern distribution than *Cercosaura.*

It should be noted that the loreal in *Pantodactylus* and *Cercosaura* is large and usually in contact with the labials. The loreal in *Leposoma* and *Alopoglossus* is small and separated from the labials by the nasal and the frenoocular. When the loreal does not reach the labials in specimens of *Cercosaura* or *Pantodactylus* it is primarily the result of an enlarging of the frenoocular. In *Leposoma* and *Alopoglossus* there appears to be a shortening of the snout, a posterior enlarging of the nasal and a reduction in the size of the loreal with the resulting failure of the loreal to come in contact with the labials.

The close relationship between *Leposoma* and *Alopoglossus* and between *Cercosaura* and *Pantodactylus* is made evident by the summary of generic characters given below.

Dorsal scales.

Leposoma: Keeled, mucronate, leaf-shaped (fig. 6), or hexagonal, in diagonal and transverse rows.

Alopoglossus: Keeled, mucronate, broad or leaf-shaped, never hexagonal, in diagonal and transverse rows (posterior dorsals of *copii* are in longitudinal rows).

Cercosaura: Keeled, rectangular, in longitudinal and transverse rows (fig. 7).

Pantodactylus: Keeled, lanceolate (fig. 5) or hexagonal, in diagonal and transverse rows.

Lateral scales.

Leposoma: Like the dorsals (fig. 6).

Alopoglossus: Like the dorsals.

Cercosaura: Much smaller than the dorsals (fig. 7).

Pantodactylus: Like the dorsals or slightly smaller (fig. 5).

Loreals.

Leposoma: Small, separated from the upper labials by the frenoocular and the nasal (fig. 2).

Alopoglossus: Small, separated from the upper labials by the frenoocular and the nasal.

Cercosaura: Large, usually in contact with the labials; may be divided (fig. 3).

Pantodactylus: Large, usually in contact with the labials (fig. 4).

First superciliary.

Leposoma: Lateral in position not expanded dorsally.

Alopoglossus: Lateral in position, not expanded dorsally.

Cercosaura: Expanded dorsally.

Pantodactylus: Expanded dorsally.

Supraoculars.

Leposoma: 4.

Alopoglossus: 4.

Cercosaura: 3.

Pantodactylus: 3.

Frontonasal.

Leposoma: Single or divided.

Alopoglossus: Single or divided. (Divided only in 2 specimens of *A. buckleyi.*)

Cercosaura: Single.

Pantodactylus: Single.

Interparietal.

Leposoma: Longer than the parietals in all species except *scincoides.*

Alopoglossus: Equal in length to the parietals.

Cercosaura: Longer than the parietals.

Pantodactylus: Longer than the parietals.

Postparietals and occipitals.

Leposoma: Not present.

Alopoglossus: Not present.

Cercosaura: Present.

Pantodactylus: Present.

Head scales.

Leposoma: With longitudinal striations.

Alopoglossus: Smooth or with longitudinal striations on the interparietal and parietals.

Cercosaura: Smooth.

Pantodactylus: Smooth.

Tongue.

Leposoma: With imbricate scale-like papillae.

Alopoglossus: With oblique plicae.

Cercosaura: With imbricate scale-like papillae.

Pantodactylus: With imbricate scale-like papillae.

Gulars.

Leposoma: Not enlarged or differentiated into two longitudinal rows.

Alopoglossus: Not enlarged or differentiated; enlarged; or differentiated into two longitudinal rows of transversely enlarged scales.

Cercosaura: Differentiated into two longitudinal rows of transversely enlarged scales.

Pantodactylus: Differentiated into two longitudinal rows of transversely enlarged scales.

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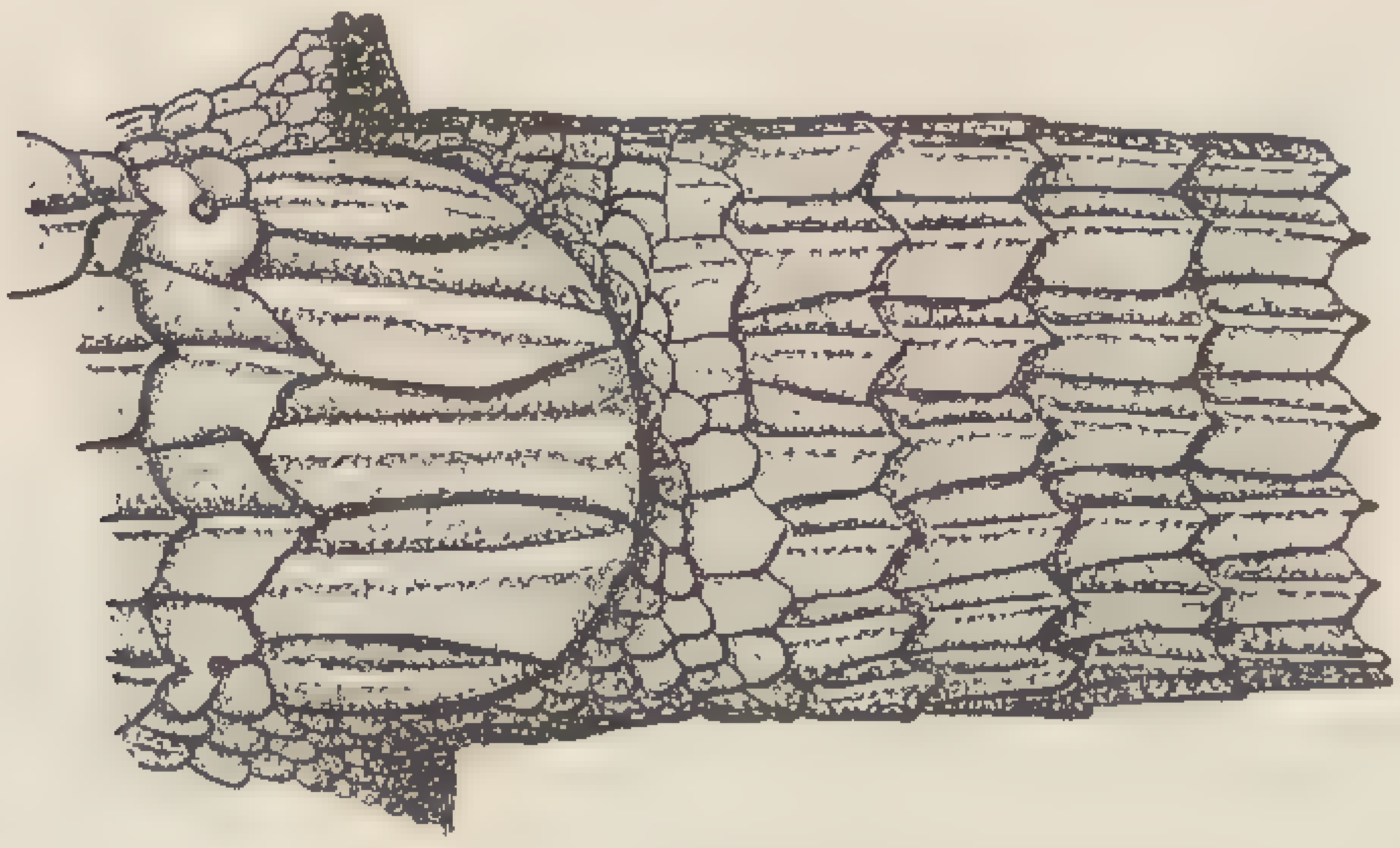


Fig. 1. Preanal scales of *Leposoma guianense* sp. nov. (type, U.M.M.Z. 46770).

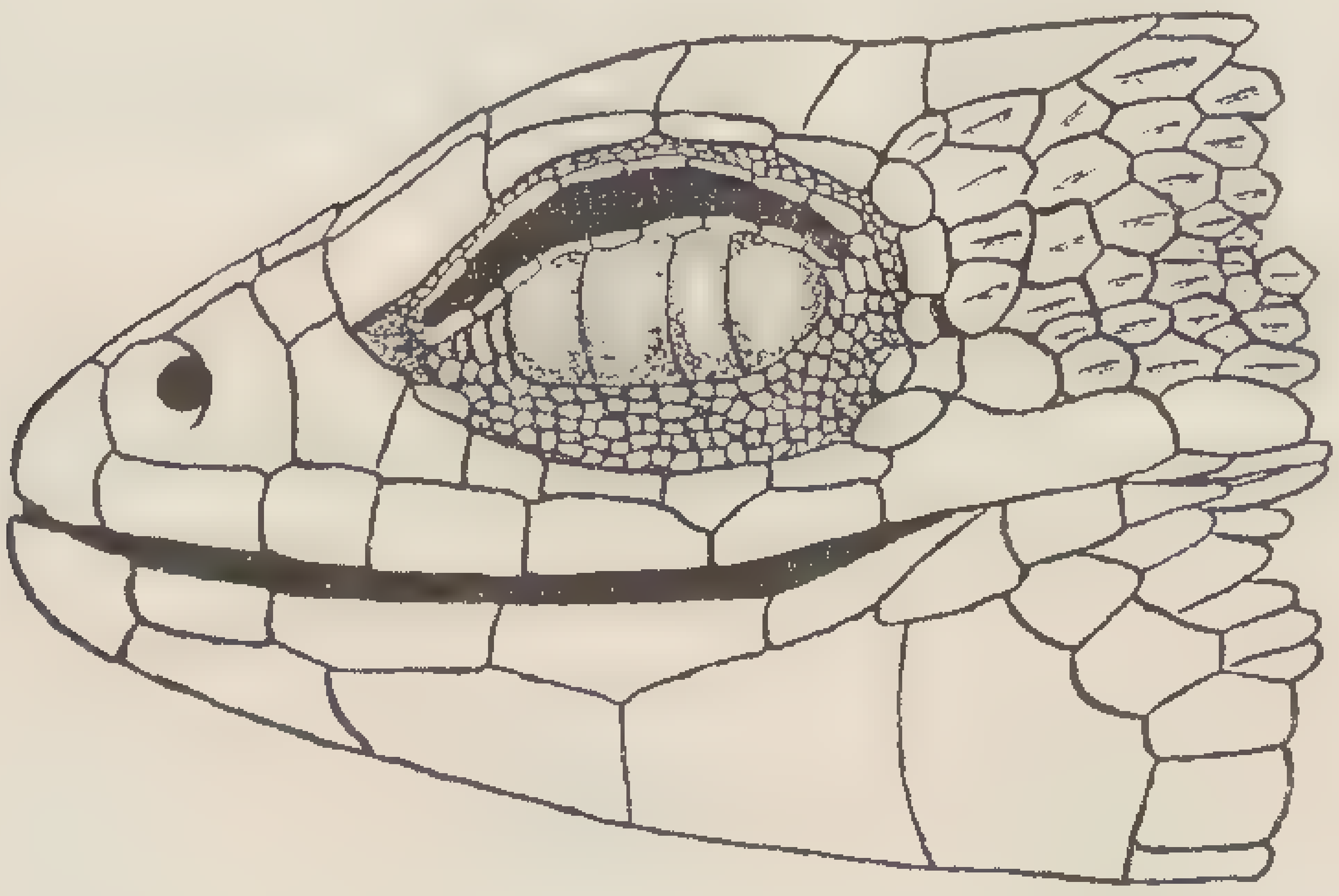


Fig. 2. *Leposoma guianense* sp. nov. (type U.M.M.Z. 46770). Lateral view of head showing reduced loreal typical of all species of *Leposoma.*

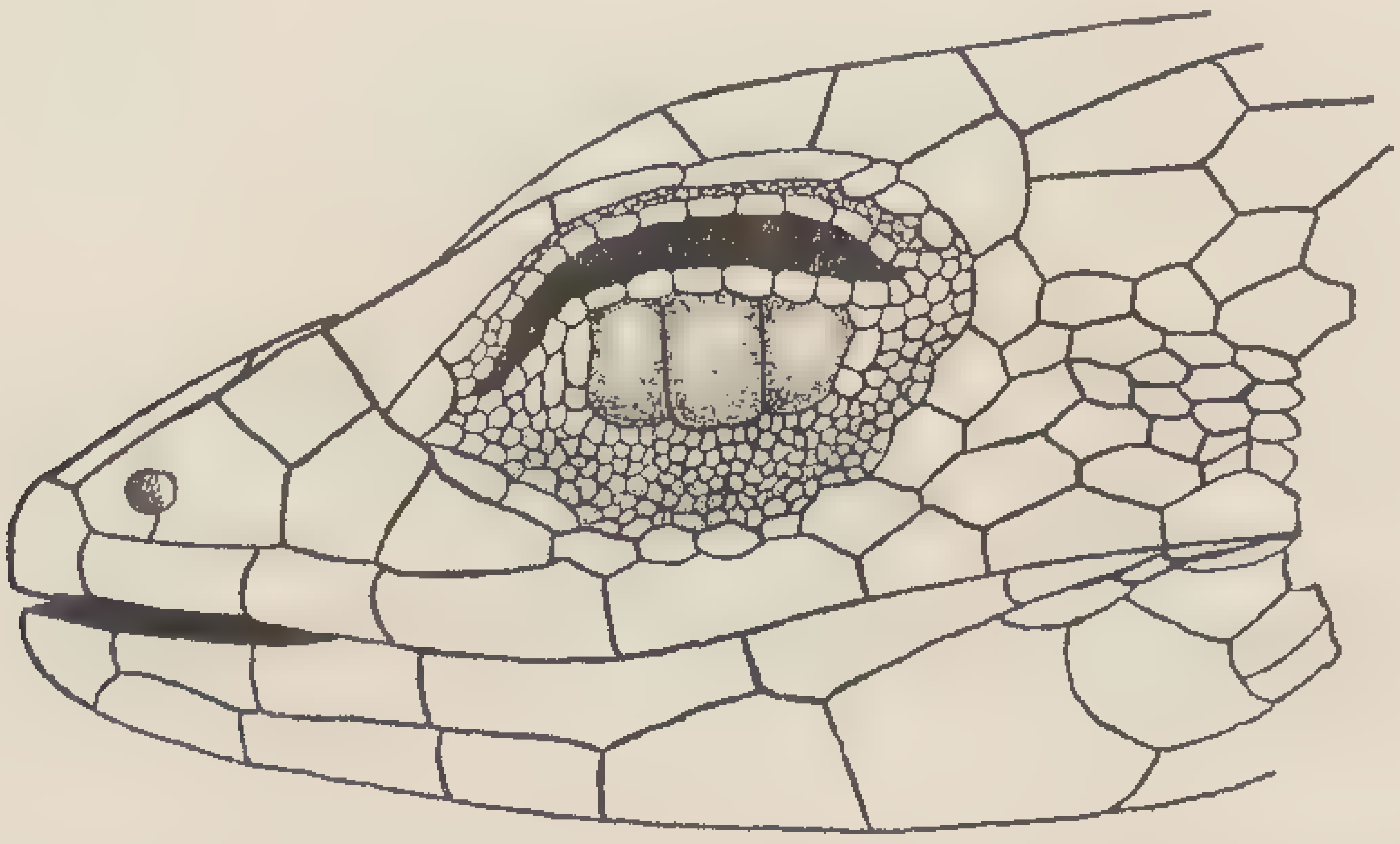


Fig. 3. *Cercosaura ocellata bassleri* subsp. nov. (A.M.N.H. 56391). Lateral view of head showing divided loreal.

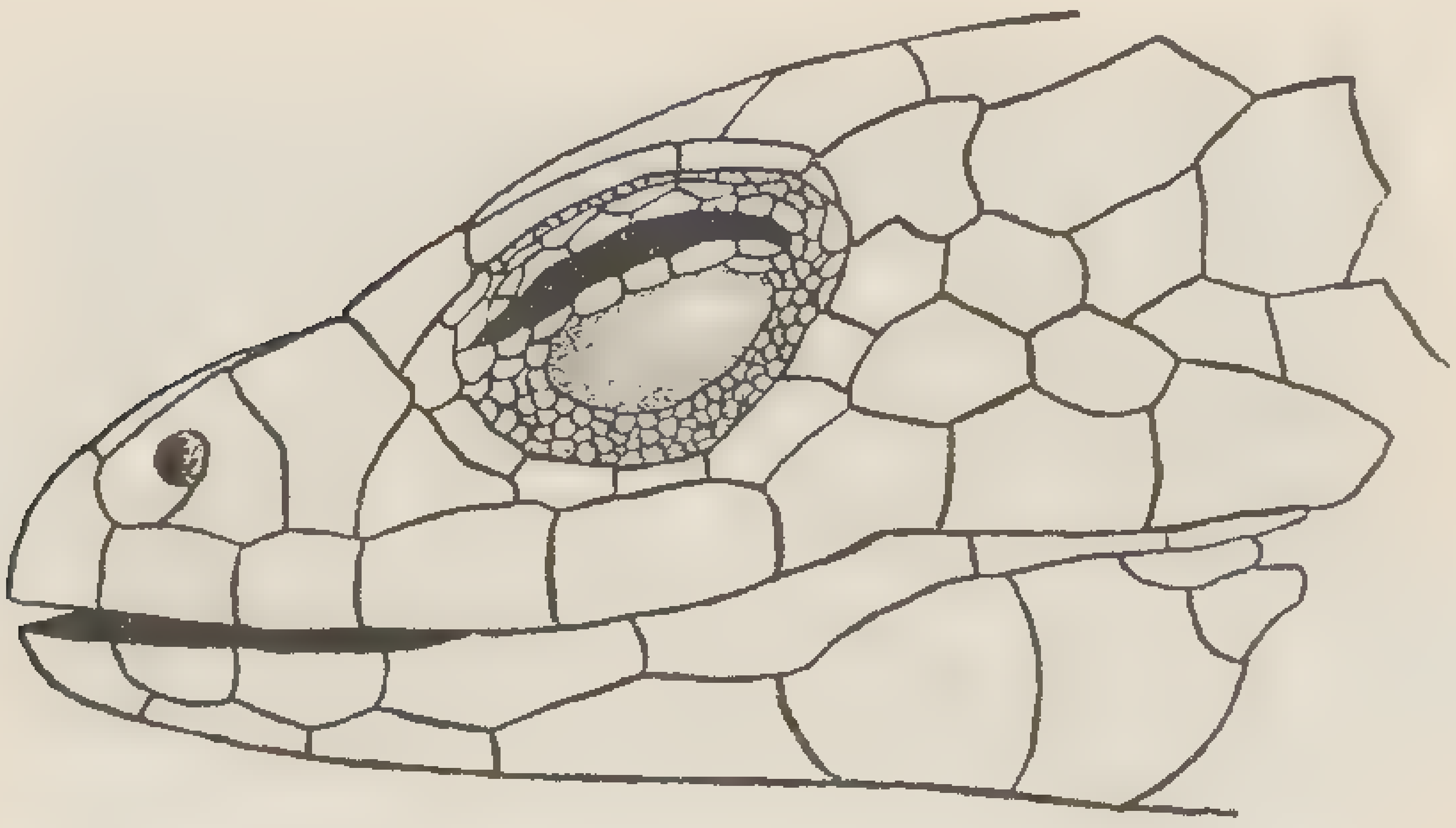


Fig. 4. *Pantodactylus schreibersii schreibersii* (M.C.Z. 22156). Lateral view of head showing large loreal typical of all species of *Pantodactylus*.

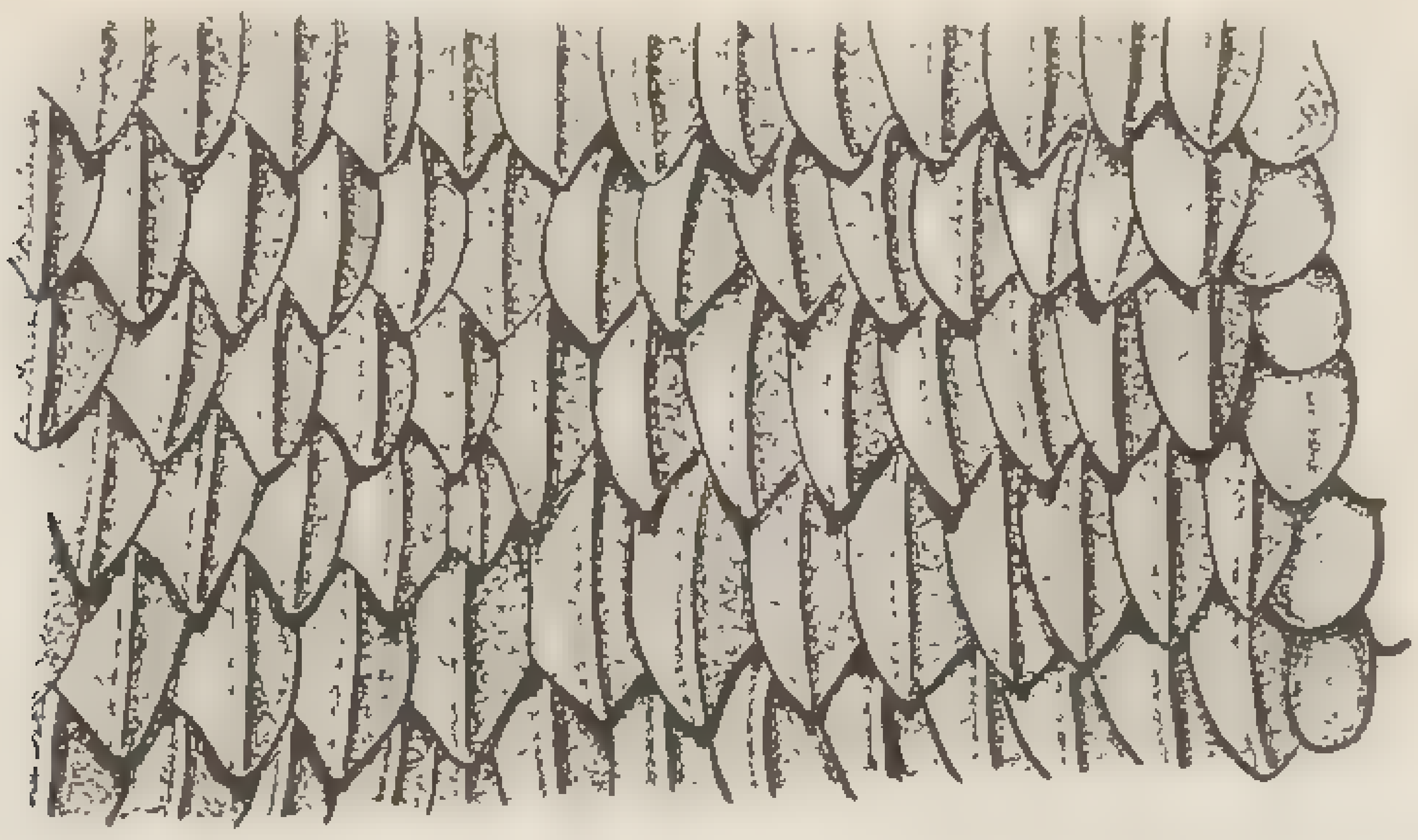


Fig. 5. Dorsal and right lateral scales of *Pantodactylus schreibersii schreibersii*.

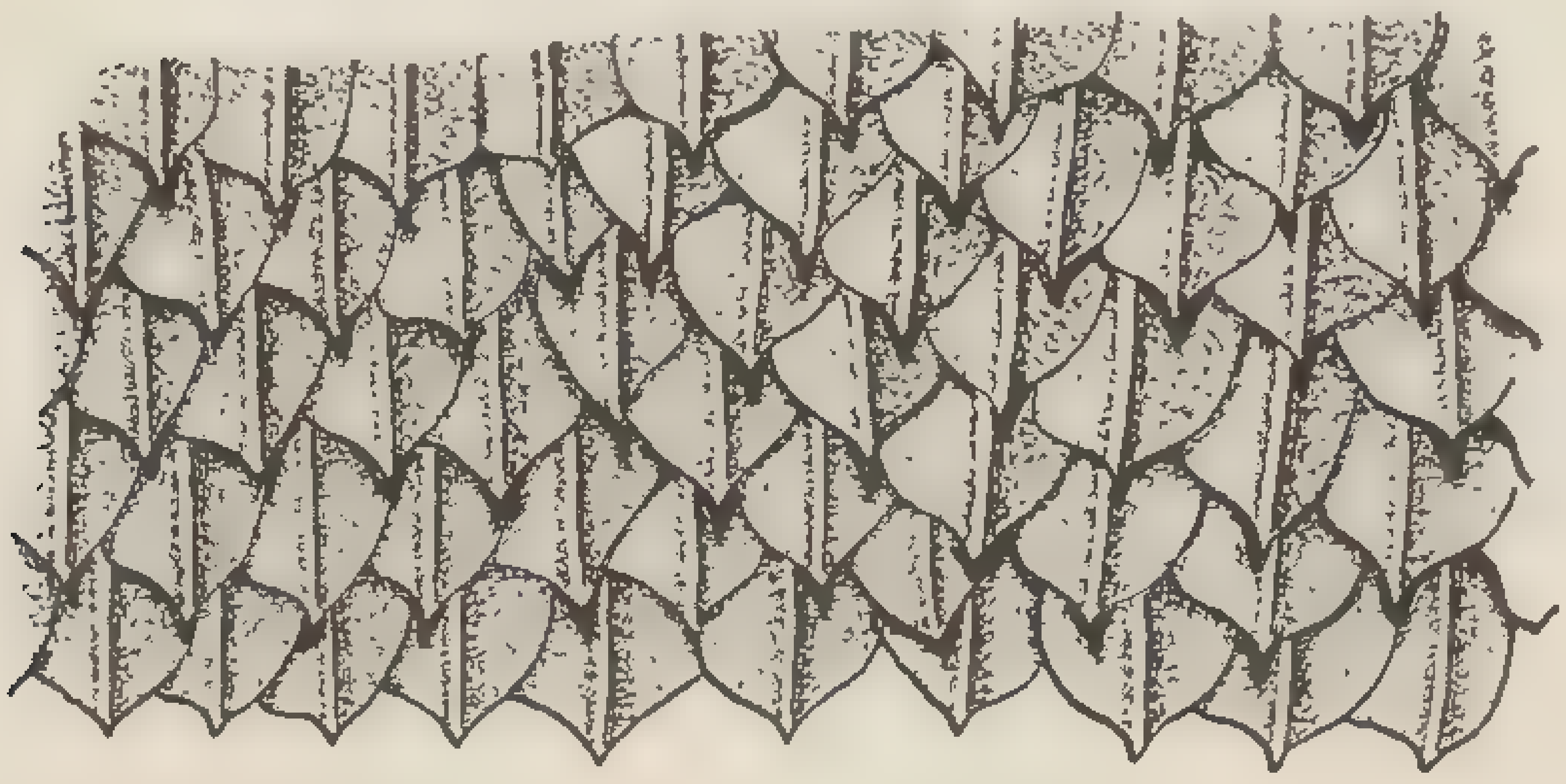


Fig. 6. Dorsal and right lateral scales of *Leposoma percarinatum*.

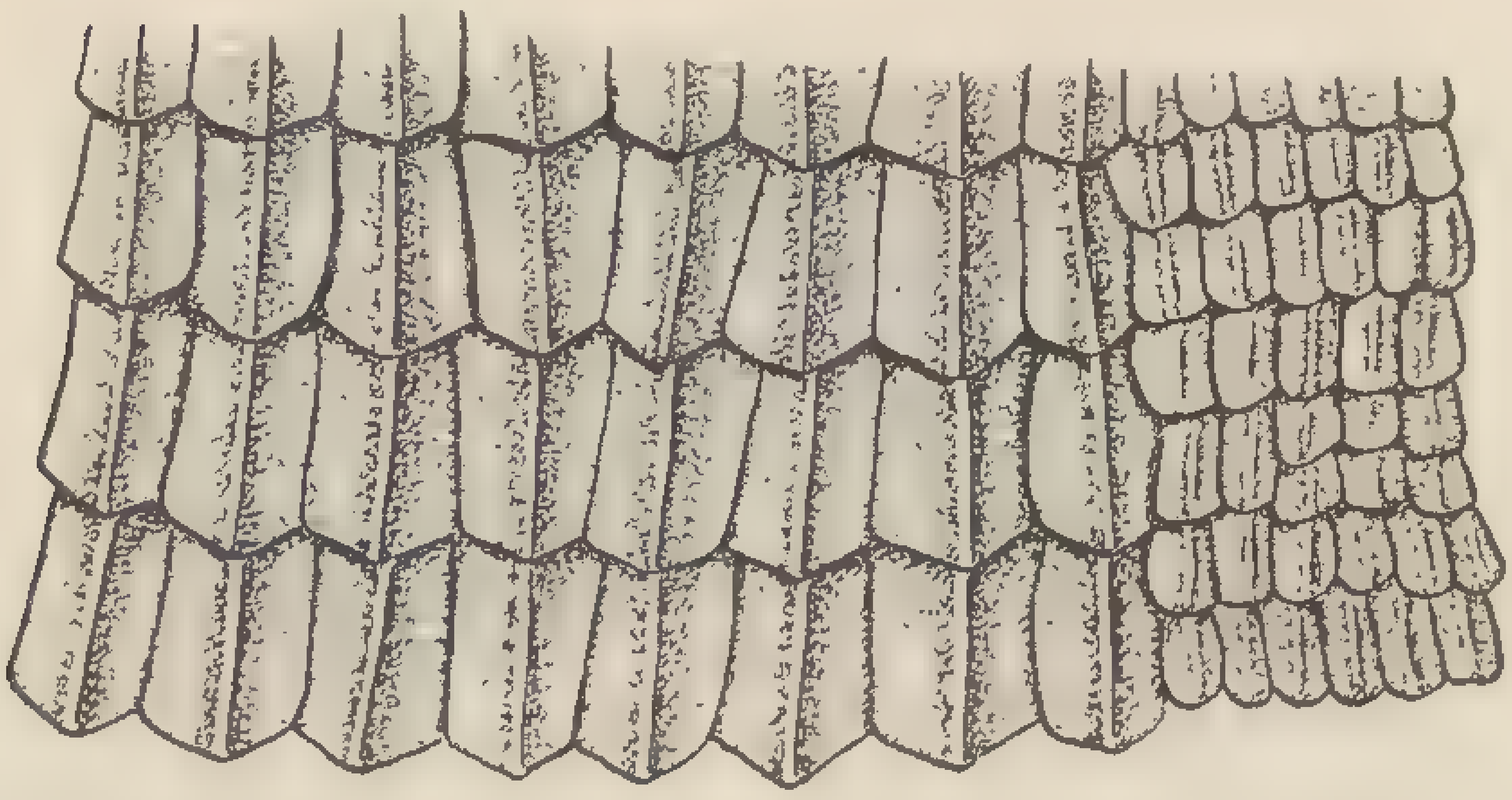
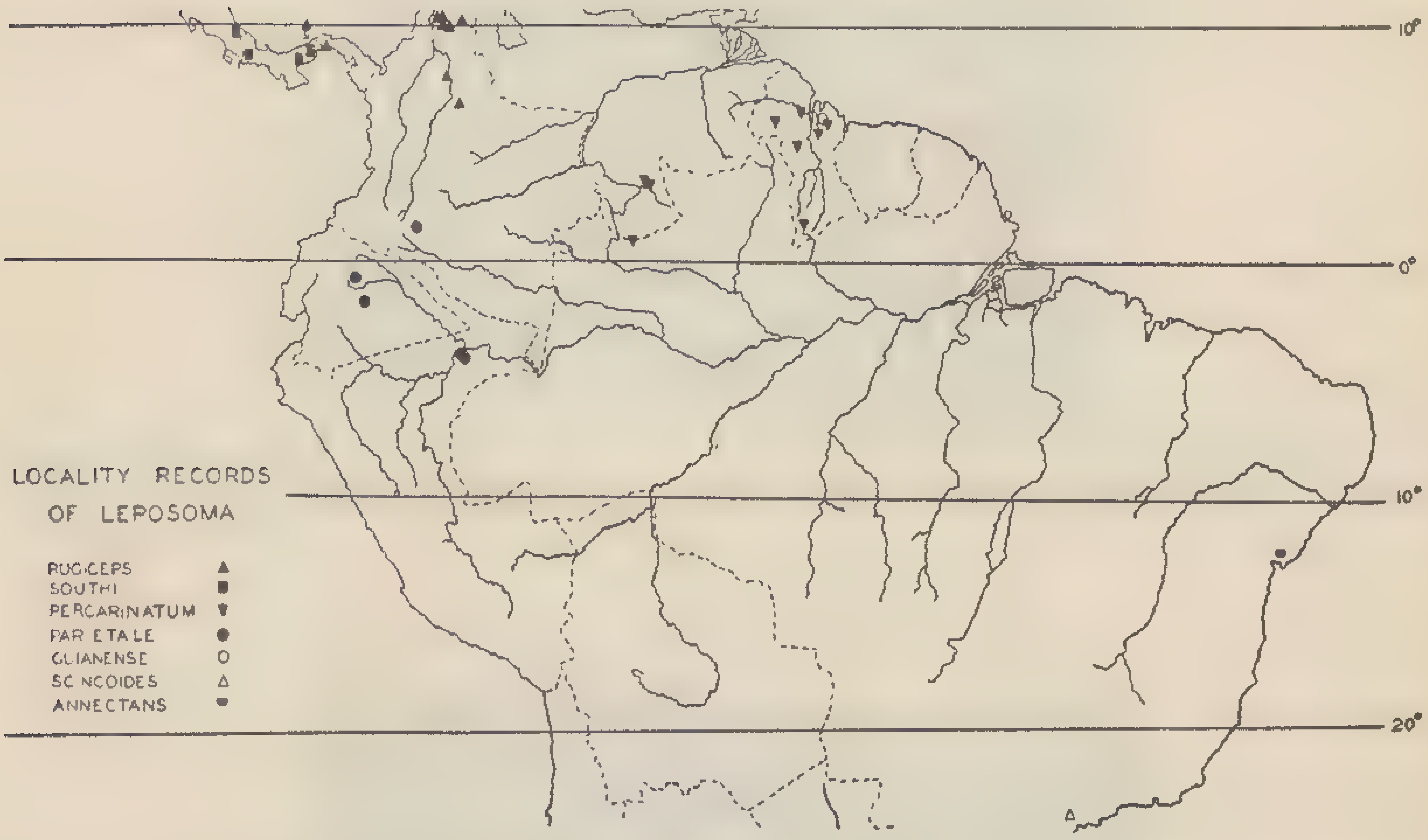


Fig. 7. Dorsal and right lateral scales of *Cercosaura ocellata ocellata.*



10°
0°
10°
20°
LOCALITY RECORDS
OF LEPOSOMA
RUGICEPS ▲
SOUTHI ■
PERCARINATUM ▼
PARIETALE ●
GUIANENSE ○
SCINCOIDES △
ANNECTANS ◓

Fig. 8. Map showing the distribution of the species of *Leposoma,* based upon the locality data of specimens examined.

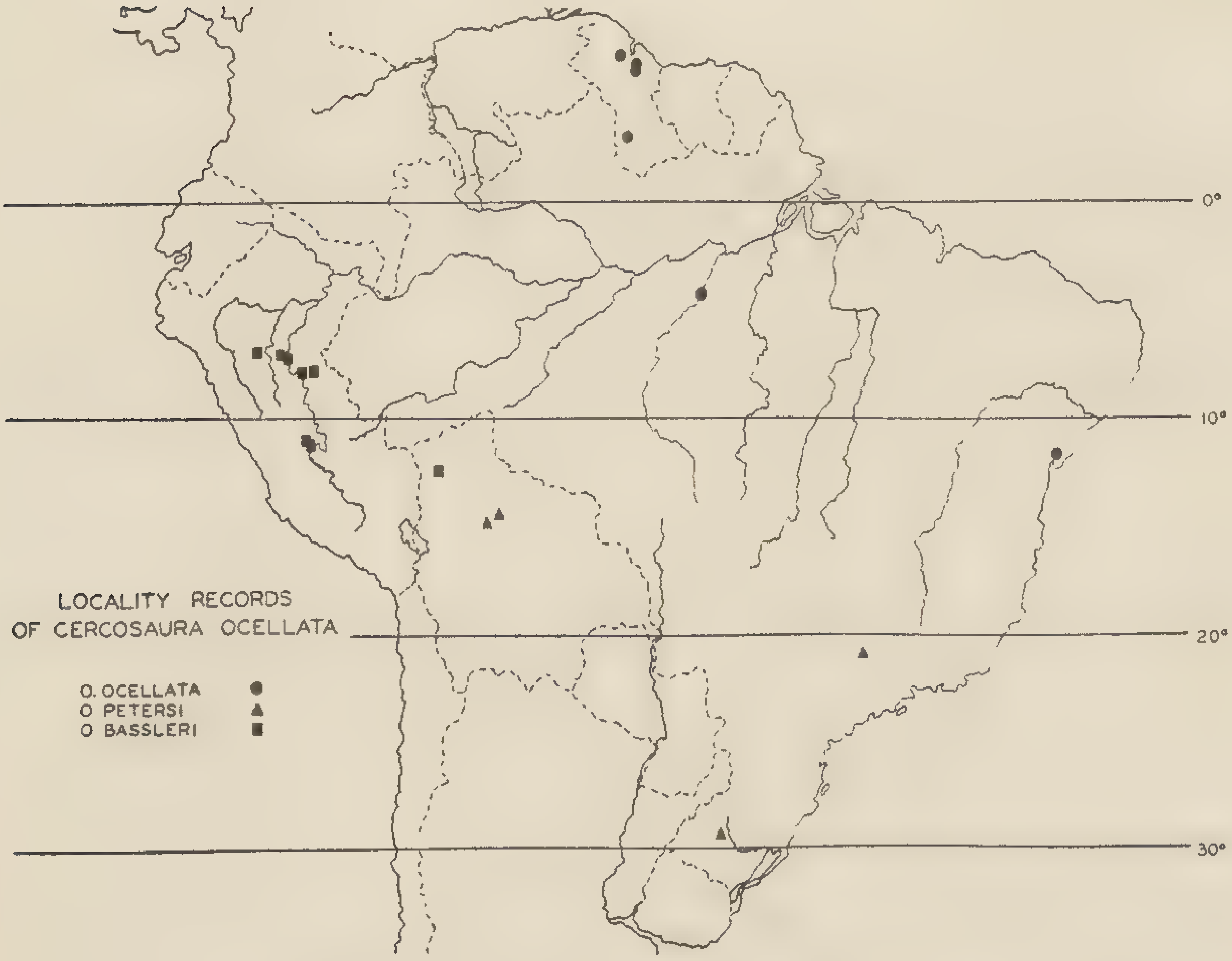
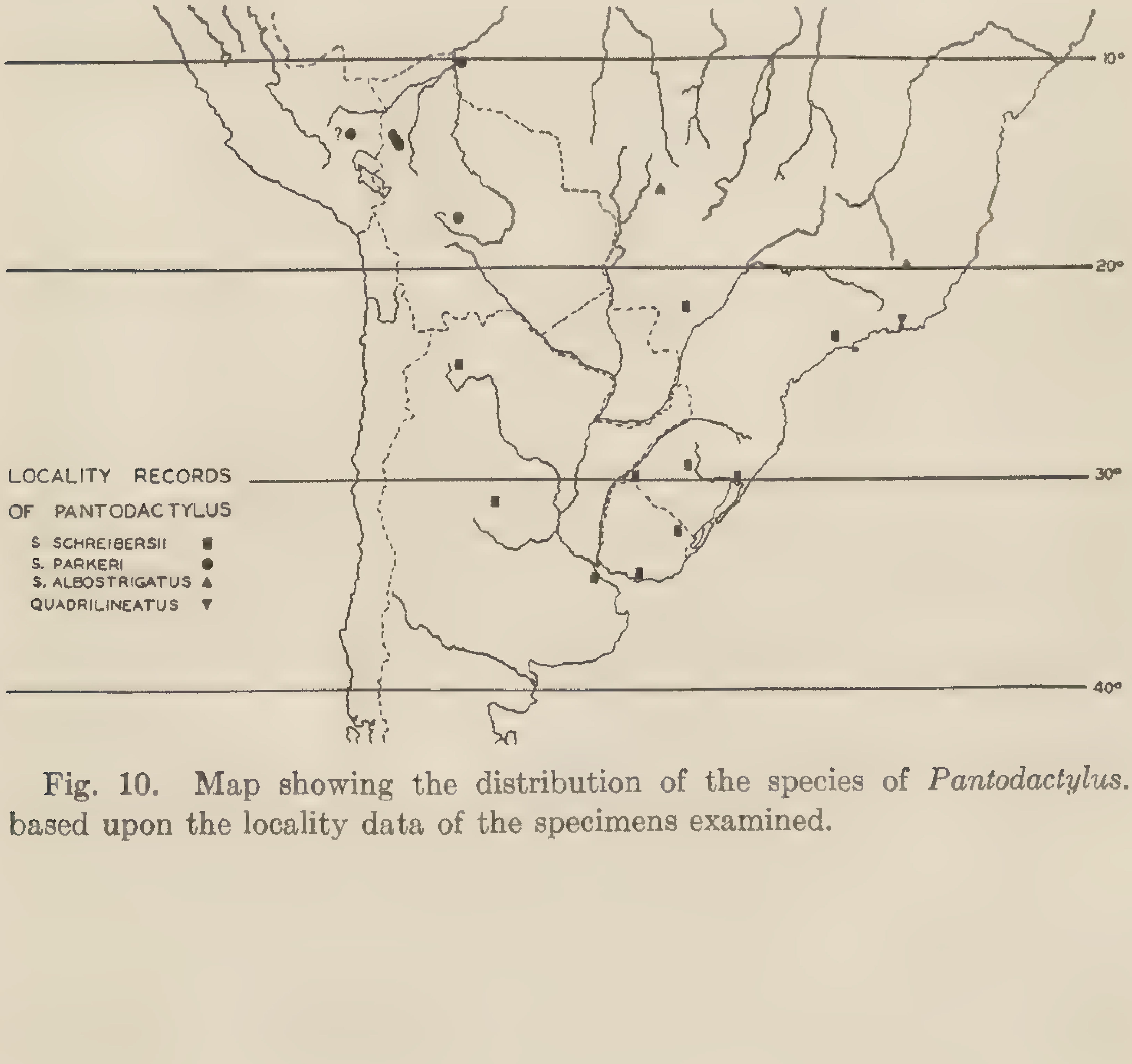

0°
10°
LOCALITY RECORDS
OF CERCOSAURA OCELLATA
20°
O. OCELLATA ●
O PETERSI ▲
O BASSLERI ■
30°

Fig. 9. Map showing the distribution of the subspecies of *Cercosaura, ocellata,* based upon the locality data of the specimens examined.


10°
?
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LOCALITY RECORDS
OF PANTODACTYLUS
30°
S SCHREIBERSII ■
S. PARKERI ●
S. ALBOSTRIGATUS ▲
QUADRILINEATUS ▼
40°

Fig. 10. Map showing the distribution of the species of *Pantodactylus.* based upon the locality data of the specimens examined.

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